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WORLD OIL

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SPECIALIZED FOR EXPLORATION, DRILLING AND PRODUCING OPERATIONS AND MANAGEMENT

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Red letter days are coming up . . .

MAY 14 THROUGH MAY 23 will be red letter days for the oil industry. During these 10 days, oil men from all parts of the world will visit the International Petroleum Exposition in Tulsa. As a special service to the oil industry, WORLD OIL will provide the following for those attending the exposition . . . and for those unable to be on hand.

• Full information about equipment on display will be presented in a special Exposition section of the May issue of WORLD OIL. For oil men unable to attend the Exposition, this will be a next-best look at exploration, drilling and production exhibits as new as tomorrow.

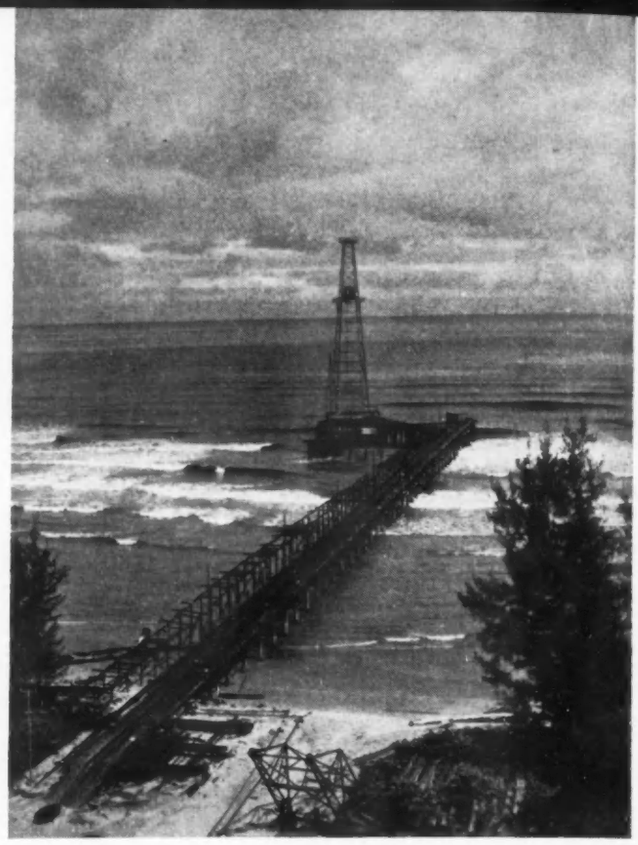
• Once again WORLD OIL will provide the Exposition Guide Book that was so popular at the 1953 show. It will be the most complete directory of equipment available.

Watch for your May Exposition Issue of WORLD OIL and don't fail to get your Exposition Guide Book. And while at the show, drop by the Gulf Publishing Company booths (181-182 and 149-150) in the center of the Oklahoma Building.

WORLD OIL published every month except semi-monthly in February and August. Second class postage paid at Houston, Texas

a Quick Look at this month . . .

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first



☐ **Expected high demand makes outlook good . . .** The oil industry's outlook continues promising, primarily because demand for petroleum is due to break all records in 1959. Crude production and refinery runs will increase even more than demand. For there will probably be some expansion of product inventories in addition to supplying current demand. In 1958, crude production and refinery runs were held below consumption levels, with part of the requirements met by drawing on storage of crude and products. . . . . **Page 25**

☐ **Here's how to pump a triple completion . . .** In this WORLD OIL exclusive you will find the *first* complete technical description of the oil industry's *first* triple pumper. For a detailed report on this unique cost-cutting method, including equipment considerations and installation procedures for medium depth range wells, turn to . . . . . **Page 91**

☐ **Will drilling increase in Western Anadarko? . . .** One of the least publicized oil and gas provinces in the Mid-Continent Area centers in the northeastern corner of New Mexico extending along the boundaries of the Texas and Oklahoma Panhandle northward many miles into Colorado. In this region of several thousand square miles, where not even one well per 100 square miles has been drilled to date, may be found all the prerequisites for oil and gas accumulation. Geologists and producers seeking new "oil pastures" should check this area described by a top authority on Anadarko Basin geology. Turn to. . . . . **Page 94**

☐ **Unique program combats external tubing corrosion . . .** Deposit attack on external tubing is a serious and expensive production problem. For an excellent case history describing how one company is successfully combating this type of corrosion with a three-phase control program, turn to. . . . . **Page 98**

☐ **Offshore work proceeds in South China Sea . . .** Offshore prospects in North Borneo are being evaluated rapidly by three Royal Dutch Shell companies with seaborne seismograph and gravity surveys. Rigs are being used that are capable of drilling in 150-foot depths. For complete details on the difficult correlation problems that are being encountered between onshore subsurface and offshore seismic data, turn to. . . . . **Page 124**

☐ **When to cut the drilling line? . . .** Drilling lines are an expensive item in every contractor's budget—and indiscriminate cutting procedures can up costs even more. Ways to reduce such costs through a well-planned program that insures a cut of proper length at the proper time are explained on. . . . . **Page 103**

☐ **Know your mud pump (Part 8) . . .** To properly understand the pressure relationship of a mud pump, it is necessary to examine the pressure developed within the mud pump cylinders on each side of the piston. This article in the widely acclaimed mud pump series discusses ways to determine these pressures. Turn to . . . . . **Page 107**

☐ **Liquid gravity and density conversion chart . . .** Here's a chart which will prove useful in the doghouse, knowledge box or briefcase. Gravity conversions can be obtained quickly, with only a straight edge required. This one's a must for your files. Turn to **Page 110**

☐ **Raton Basin potential excellent in Colorado . . .** The Colorado portion of the Raton Basin provides excellent potential for oil finders. For a complete report on the oil and gas possibilities of the area, as revealed by new interpretations of subsurface studies, turn to . . . . . **Page 115**

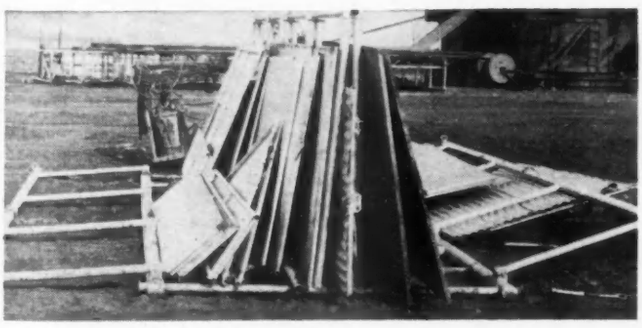
☐ **Water can be controlled in air and gas drilling . . .** Two different materials that have been developed and are adaptable for most of the varied water control conditions encountered in air and gas drilling are discussed on **Page 111.** One is a very low viscosity solution that sets to form a still gel. The other is a liquid synthetic resin that can be used singly or in a slurry with loss additives.

☐ **What geological criteria should be applied** when determining whether to drill a field or pool prospect so as to minimize loss and assure the greatest profit? In this two-part series, "How to Appraise Wildcat Prospects," the author presents a rule of thumb for the profit-to-risk ratio which has paid off handsomely for his company—and which may be applied with equal success by other operators. . . . . **Page 119**

☐ **Congress to increase oil industry probes . . .** What is the outlook for oil during the 86th Congress? Will depletion hold its own? What are the chances for passage of remedial legislation for natural gas? For answers to these important questions, plus expert predictions on the outcome of major oil industry legislation during this session of Congress, turn to. . . . . **Page 121**

☐ **Earnings outlook promising after good fourth quarter . . .** The outlook for oil industry earnings in 1959 is promising. Increased demand for petroleum will result in larger volumes of crude production and refinery runs and more sales of oils. The larger volumes of business will help to offset recent reductions in crude oil prices. Earnings continued to improve in the fourth quarter of 1958 for a majority of oil companies. **Page 122**

☐ **Reservoir Study Fundamentals (Part 7) . . .** A thorough understanding of basic requirements, objectives and limitations of reservoir investigations is essential to obtain accurate future predictions. For a highly informative discussion of these factors, turn to **Page 130**



☐ **Fold-out rack reduces cost of moving rig paneling . . .** An easily built rack can cut winterized panel moving costs to a minimum. An excellent example of such a rack—one that will permit the transportation of all pieces safely in a single, compact package—is described on . . . . . **Page 123**

next month . . .

WHO? Gulf Publishing Company

WHAT? 1959's Complete and Authoritative Special Exploration Issue

WHEN? April 1

WHERE? In WORLD OIL

WHY?

To furnish technicians concerned directly with oil-finding techniques and procedures with the latest developments in their field of operations

HOW?

For the past six months, the WORLD OIL editorial staff has traveled several thousand miles and consulted with top industry authorities to obtain the most up-to-date and accurate information available on exploration techniques, equipment and trends.

To further illustrate WORLD OIL's policy of maintaining highest editorial quality, the following authors are typical "men from industry" who have contributed to the 1959 Exploration Issue:

Hardy

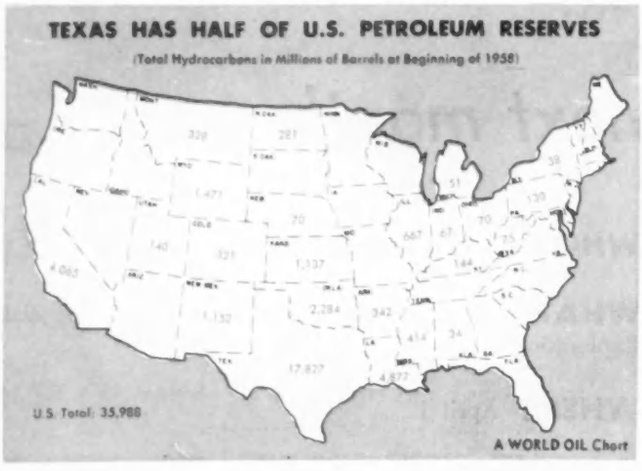
Van Siclen

Pratt

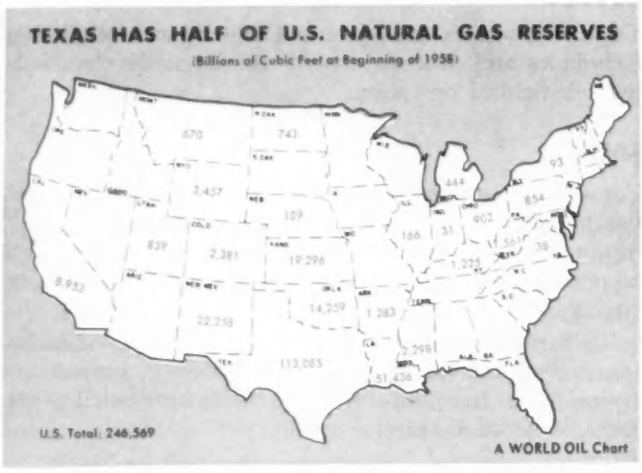
• **H. W. Hardy**—author of an article on continuous velocity logging which will appear in the Exploration Issue. He is a senior seismic computer in Geophysics Research in Humble Oil & Refining Company's Geophysics Research Group in Houston.

• **Dr. DeWitt C. Van Siclen**—author of an article dealing with seismic velocity effects as applied to organic reefs, which will appear in April. Dr. Van Siclen is a senior geologist with Pan American Petroleum Corporation in Houston.

• **Ernest A. Pratt**—author of next month's article on advances in geophysical instrumentation is sales manager of Southwestern Industrial Electronics Geophysical Products Division.


TEXAS HAS HALF OF U.S. PETROLEUM RESERVES
(Total Hydrocarbons in Millions of Barrels at Beginning of 1958)
U.S. Total: 35,988
A WORLD OIL Chart

(Substitute this map on Page 156, February 15, 1959, WORLD OIL)



(Substitute this map on Page 162, February 15, 1959, WORLD OIL)

Figures on location of oil, gas reserves in the U. S. corrected

TEXAS, LOUISIANA, California and Oklahoma accounted for more than 80 percent of the total liquid hydrocarbon reserves located in the U.S. at the beginning of 1958. Of the total of more than 27 billion barrels, Texas alone was credited with almost 50 percent.

And five states—Texas, Louisiana, New Mexico, Kansas, and Oklahoma—account for about 90 percent of total U.S. natural gas reserves of almost 247 trillion cubic feet. Again, Texas accounted for approximately half of that amount.

For clarification, the two maps above are republished from WORLD OIL's Feb. 15, 1959, Forecast-Review Issue because the figures on the hydrocarbon reserves map (page 156) and the natural gas map (page 162) were inadvertently transposed in the process of publication.

Readers who use this Forecast-Review Issue for reference can substitute the corrected maps on those pages.

Extra copies of this issue are available for $1 each.

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PIPE LINE INDUSTRY and THE PIPE LINE CATALOG for the LOG for the oil and gas pipe line industry.

Indexed by Industrial Arts Index and Engineering Index

Looking Ahead

Will steel workers strike in '59? . . . Cautious optimism is developing. Steel workers union is not in good financial shape to undertake prolonged strike. Leaders are wary of possible public condemnation for renewing inflationary spiral through excessive demands. Thus, chances are improving for peaceful, negotiated contract with steel companies.

First triple pumper now in operation . . . Recently completed by Midland, Texas oil operator Richard S. Anderson in Garza County's Rocker "A" field, the new development includes following unique features:

- Three insert pumps run in tandem on single string of hollow sucker rods.
- String of 1-inch production tubing is run and seated in a cross-over shoe independent of the main 2-inch tubing string. The 1-inch serves as conduit for fluid from one producing zone.
- All pumps are actuated by a single pump jack at the surface.
- Two packers separate the three producing zones, and all equipment was run through 5½-inch casing. (See Page 91).

Alaska's exploration boom continues . . . In mid-February, Interior Secretary Seaton gave Union Oil and Ohio Oil green light to develop oil and gas lands in 229,000-acre area of Knik-Arm, off Alaska's Cook Inlet. Under 4-year contract, companies must spend $450,000 and drill three exploratory wells.

Oil won't be only target in depletion probes . . . Congress may check depletion provisions of virtually all extractive industries. Attention is being given brick and tile manufacturers, who may compute depletion of their resources (lime, silica, clay) on basis of finished product prices. This would be tantamount to oil producers calculating depletion on basis of gasoline prices.

Much credit for more responsible Congressional review of depletion problems may be due Treasury Secretary Robert Anderson, whose experience in mining industry as well as oil affords sound basis for study.

Gulf Oil announces major drilling breakthrough . . . New development is water shutoff process for air-gas rotary drilling. Gulf engineers say technique eliminates need to inject chemicals or chemical-gas. Instead, a special easily obtained gas is injected into porous sand producing undesired water. Water-insoluble precipitate is then formed which plugs openings in sand grains about 12 inches around the well bore.

Company reports process is 99-100 percent successful in stopping water flows ranging from 2 to 2,200 gallons per hour; can result in savings of up to 25 percent in air-gas drilling costs.

Oil industry's greatest decade? . . . Oil and natural gas will supply 72 percent of U.S. energy needs by 1968—so predicts Thomas W. Phelps, economics department manager, Socony Mobil Oil Company. U.S. energy consumption is expected to rise 3.2 percent yearly during the coming decade. Oil demand is expected to grow from 8.8 million barrels daily now to 12.2 million barrels per day in 1968, with an average increase of 3 percent per year. Natural gas use will increase 4.6 percent annually.

Corporations keep closer tab on economic trends . . . In recent survey of 309 of the nation's top corporations, Socony-Mobil found that 30 percent have one or more economists on the staff, another 50 percent use outside economic counsel. Similar survey made by National Industrial Conference Board in 1950 indicated that only 10 percent used full-time economists.

Reason for industry's increased reliance on economists is summed up by one of the respondents to Socony-Mobil's survey: "Because of the accuracy of predictions during the past five years, management can now place more reliance on the judgment of its economists than it did before."

CATC makes second quadruple completion . . . The CATC Group has completed its second quadruple offshore well, using four strings of tubing. It is located on the same platform in the West Delta Block 45 where the first quadruple completion was drilled last June. The second well actually encountered five sands, but the fifth was not considered commercially producible. Total net pay in the well is 182 feet.

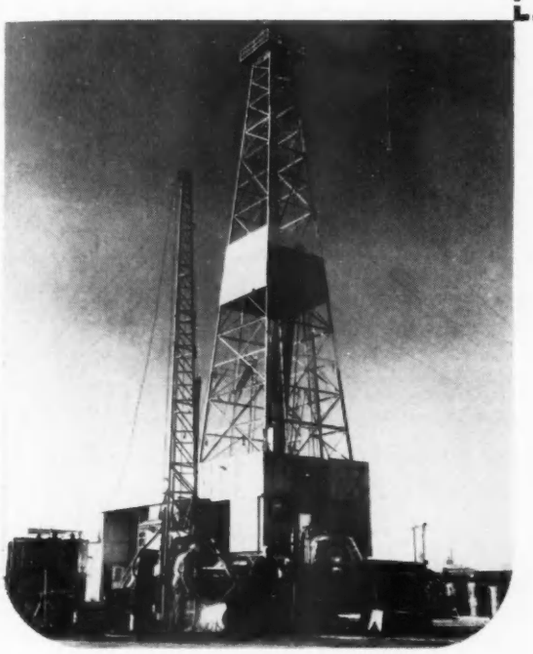
The first zone, perforated from 6,824 to 6,830 feet, tested at a rate of 225 barrels daily through 10/64-inch choke; the second, 8,989 to 8,995 feet, tested at 214 barrels daily through ⅛-inch choke; the third, 9,280 to 9,285 feet, tested at 359 barrels daily through 9/64-inch choke; and the fourth, 9,648 to 9,653 feet, tested at 340 barrels daily on 9/64-inch choke.

Patent granted on jet deflection method . . . California Company's recently developed method of using conventional jet bits instead of whipstocks to drill directional wells has been granted Patent No. 2,873,092. (See October WORLD OIL, Page 137). This cost-cutting technique is now available to those who wish to use it, under license from the California Research Corporation.

New Automatic Well Test System . . . Shell Oil recently installed newly developed equipment in Bayou Sorrell, Louisiana field. System automatically performs control functions necessary to test individually and record production performance for 35 wells. Information and data for tests are recorded by tape punching device similar to that used for teletype.

Test unit uses combination programer and data recorder. Programer automatically switches wells into test unit in pre-selected sequence and for pre-selected time. After well has been tested, it is switched back into test unit. Initial operation at Bayou Sorrell was so successful, Shell is installing three more testing units in South Pass Block 24 field, and one unit in Louisiana's White Castle field.

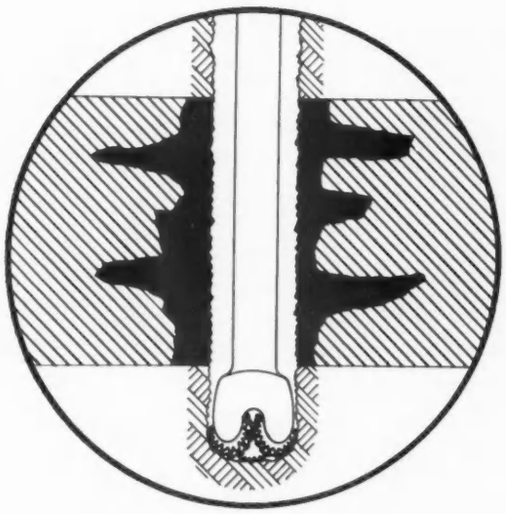
HALLIBURTON HYDRO-LOK



THE ANSWERS TO BETTER WATER CONTROL

A major problem in air and gas drilled wells is the control of in-flow water. Halliburton HYDRO-LOK . . . a group of three effective water control agents has been specifically developed to help solve this troublesome problem.

HYDRO-LOK (PC-11) consists of a thermosetting resin and inert solids. It forms an insoluble plug having high compressive strength, resulting in an effective seal . . . May be placed like cement slurry, either dumped with bailer or pumped opposite the formation by the two-plug method. When the squeeze pressure is applied, the resin enters the formation where setting is accelerated on contact with interstitial water . . . Adaptable for zones of high permeability, fractured sandstones and limestones. Because of the low viscosity of the resin phase in the slurry, relatively long sections of water producing horizons with varying permeability may be treated.



HYDRO-LOK (HG-10), the resin used in PC-11, contains no inert solids; therefore, its primary application is for conditions where maximum resin penetration is required.

HYDRO-LOK (PWG) is a low viscosity fluid that sets to form a stiff gel. The low viscosity is maintained for 95% of its pumping time, aiding entry into the true permeability of the water bearing formation. When PWG enters its setting phase, an extremely stiff gel results in less than an hour, thus minimizing costly rig downtime. Other advantages of HYDRO-LOK (PWG) include:

- **Holding back relatively high formation pressure.**
- **Adjustable to well temperatures from 32° to 200°F.**
- **Nature of set minimizes danger of sticking tools.**
- **Is insoluble in water, acid or oil.**
- **Still sets satisfactorily when diluted as much as 50% by formation water.**
- **Also useful in grouting operations and in mine shafts.**

The Halliburton HYDRO-LOK group of materials has demonstrated water control effectiveness in many field applications. For better water control in air or gas drilled wells *and* grouting operations, specify Halliburton HYDRO-LOK.

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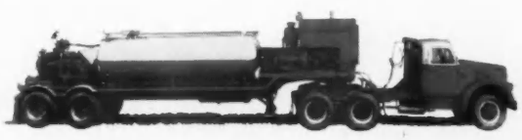

Good Wells Make Good News

A Monthly Report on Wells That Are Now Worth More

March, 1959

Here are results of some recent fracturing treatments performed by Dowell, using three of Dowell's ten basic fracturing services.

- **Lea County, New Mexico** (New Oil Well) Pay zone was the Grayburg sand between 4190 and 4209 feet. On initial test there was no production. After a 500-gallon regular acid treatment, well tested only a show of oil. Operator ordered Sandfrac®, using 20,000 gallons refined oil with 40,000 pounds sand. Injection was down casing at 20 bpm and 2900 psi. After clean-up, well tested 300 bopd. Other wells in the area treated with only 10,000 pounds sand have tested only 135 bopd.

- **Bossier Parish, North Louisiana** (New Gas Well) This well made only a show upon completion. Perforations were from 6233 to 6244 feet into the Travis Peak sand. Operator suspected that loss of mud into the formation was blocking production. He had Dowell acidize with 1500 gallons Mud Acid, after which well flowed 460 mcfd into line. To increase production further he ordered Stratafrac®, using 3500 gallons acid-kerosene emulsion with 2400 pounds sand. This was followed by 500 gallons Dowell acid with a silicate control agent added. Over 60 days after fracturing, well was still delivering 1516 mcfd to the line.

- **Clark County, Illinois** (New Oil Well) This well, completed in a 15-foot section of the tight Trenton lime, made only a show of oil and gas. Operator ordered Riverfrac®, using 155,000 gallons water with demulsifying agent and 20,000 pounds sand. 150 pounds temporary plugging agent were also used. Injection rate averaged 40.6 bpm at 1800 psi maximum pressure. After clean-up, initial production was 70 bopd flowing.

- **Liberty County, Texas Gulf Coast** (Old Oil Well) This well was dually completed into two sections of the tight Frio sand. Perforations were 8944 to 8971 and 9013 to 9068 feet. Production had declined to 40 bopd. The operator decided to fracture both zones separately and ordered Stratafrac. The lower zone was isolated and fractured with 6000 gallons fluid and 10,000 pounds sand. Then the upper zone was isolated and fractured with 6000 gallons fluid and 15,000 pounds sand. After both zones cleaned up, production from the lower sand stabilized at 45 bopd and from the upper at 55 bopd. This was a net production increase of 60 bopd and the entire treatment cost was paid out in less than two months.

Your Dowell representative can help you select the best treatment for your well. If fracturing is indicated, he can help you decide treatment size, the fluid to be used, amount of sand, injection rate, etc. For detailed information or prompt service, call the Dowell engineer in your area. In Canada, contact Dowell of Canada, Ltd.; in Venezuela, United Oilwell Service. Or write Dowell, Tulsa 1, Oklahoma.

Services for the oil industry DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

Don't underestimate Russia

THE FREE WORLD cannot afford to underestimate Russia's intention or its ability to upset established oil markets or normal channels of oil movement. The recent barter deals it has made with Brazil and other countries in both this hemisphere and in Europe, and, more recently, the importing of a tanker load of Rumanian fuel oil into the United States are but symptoms of recent trends in that direction.

It can be revealed that within the past three months, Russia has proposed a "deal" that might have had serious repercussions in the U.S. oil industry. Obviously, the proposal was aimed at the Canadian paradox wherein Canada must import crude on the East Coast to serve refineries in that area despite the existence of surplus crude oil availability in the western provinces. The East Coast imports presently amount to approximately 294,000 barrels per day of Middle East and Venezuelan crude oil and 90,000 barrels per day of oil products.

The Russian proposal actually consisted of two parts:

1. That Russia would supply Eastern Canadian refineries with about 300,000 barrels of crude daily, this oil to be laid down at a price 50 cents lower than the landed price of presently-imported Middle East and Venezuela crude on the East Coast.

This Russian crude would have been sold to the Canadian government at the 50 cents under-the-market figure, the government then reselling it to eastern refineries at the normal market price. Russia's proposal was that Canada then could have used the 50 cents to subsidize expansion of Western Canadian crude markets.

2. That Russia would agree to take—from Western Canadian ports—an equivalent amount of Western Canadian crude for shipment to Eastern Siberian supply points.

This arrangement, of course, would have meant that:

- Canadian refineries on the East Coast would have become dependent to a sizable degree upon Iron Curtain, or Communist, sources for crude oil.
- Western Canadian crude producers would have become dependent upon Russia as a market for a major portion of their production.
- The subsidizing of Canadian crude producers by 50 cents per barrel would have permitted their crude to enter U.S. and other markets with a decided price advantage and without actually cutting normal Canadian wellhead prices to producers.

The Russian proposal was rejected by Canada. But the fact that the proposal was suggested and the fact that there is no way of knowing whether additional proposals still may be made point up the gravity of the continuing Russian threat to normal world oil trade patterns.

Let your plans include the specialized knowledge and resources of the nation's Pioneer Oil Bank.

84th Year of Dependable Service

FIRST NATIONAL BANK IN DALLAS

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Expected high demand makes outlook good

Increased volumes of business will help to compensate for some recent decreases in prices of crude oil. Markets for refined products so far have remained firm

The outlook for the petroleum industry remains generally favorable, primarily because of the expected greater demand for oils in the U.S. and other free countries.

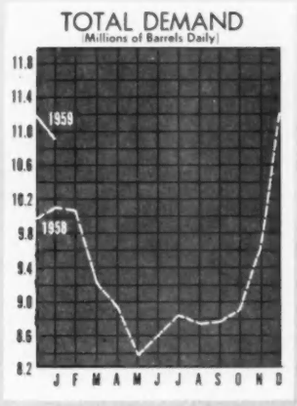
There is currently a world-wide over-supply of crude oils. It has forced crude oil prices down recently by 18 cents a barrel in the Middle East, 5 to 15 cents in Venezuela, and around 7 cents a barrel in West Texas, Oklahoma, North Texas, and other U.S. areas.

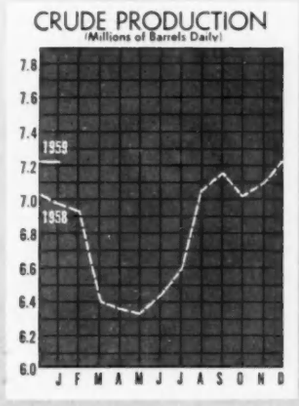
Usually, crude price reductions put downward pressure on prices of refined products. But so far, the recent crude cuts have not materially affected product prices. On the contrary, prices of heating oils were recently increased, in response to this winter's exceptionally cold weather and greater than normal consumption of those oils.

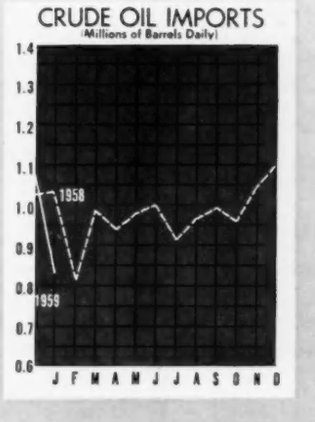
Gasoline prices meanwhile remained firm, and there have been some predictions of increases. But gasoline stocks have been increasing more than necessary. Production of that product has been increased more than was desirable in conjunction with the making of the large amounts of heating oils required.

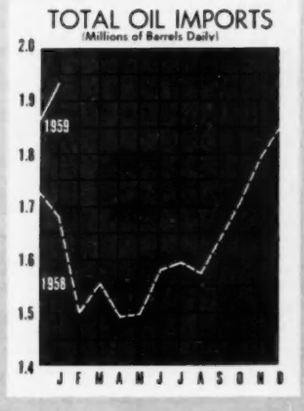
U.S. gasoline stocks had increased to 199 million barrels by Feb. 6, 1959. They were still 9 million barrels less than on the same date a year earlier. But they were already well above the 190 million barrels considered desirable March 31, 1959, on the basis of estimates offered by oil companies to the Texas Railroad Commission. And as of Feb. 6, 1959, there re-

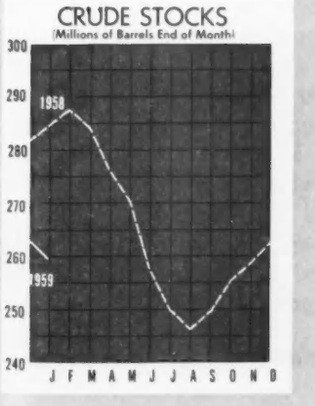
Petroleum Trends...

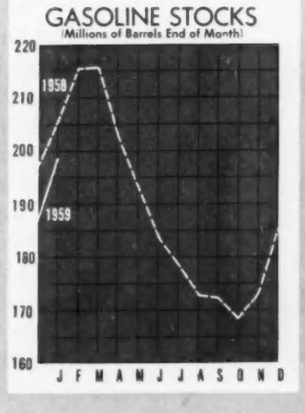


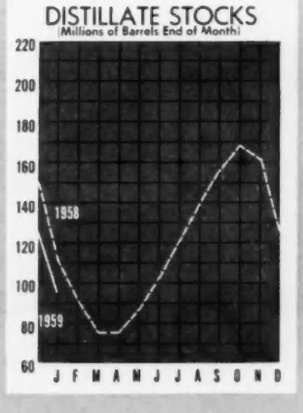


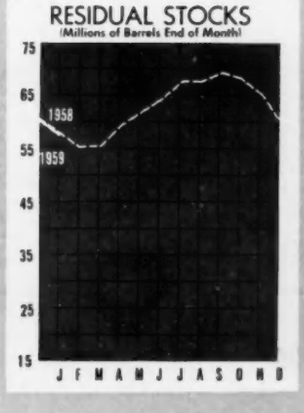












U. S. Monthly Oil Trends
(THOUSANDS OF BARRELS DAILY)

ITEM	JANUARY 1959	JANUARY 1958	% Diff.	Dec. 1958
SUPPLY				
U.S. Crude Oil Production	7,117	6,865	+ 3.7	7,105
U.S. Natural Gas Liquids Production	830	814	+ 2.0	830
U.S. Total Imports	1,924	1,817	+ 5.9	1,935
Total Crude Oil Imports	835	1,024	—18.5	1,039
East Coast Crude Imports	681	854	—25.4	792
Total Refined Products Imports	1,089	793	+37.3	803
Total New Supply	9,871	9,496	+ 3.9	9,870
Stock Changes, All Oils (Daily)	—1,081	—807	....	—1,332
DEMAND				
Total Demand, All Oils	10,952	10,303	+ 6.3	11,202
Gasoline Demand	3,664	3,527	+ 3.9	3,786
Distillate Fuel Demand	3,191	2,748	+16.1	3,091
Residual Fuel Demand	1,960	1,873	+ 4.6	1,854
Domestic Demand, All Oils	10,672	10,064	+ 6.0	10,897
Export Demand, All Oils	280	240	+16.7	305
CRUDE RUNS				
Crude Runs at U.S. Refineries	8,190	7,672	+ 6.8	7,956
Domestic Crude Runs to Stills	7,211	6,720	+ 7.3	6,952
Foreign Crude Runs to Stills	979	952	+ 2.8	1,004

KIND OF OIL	TOTAL U.S. STOCKS Millions of Barrels End of Month — JANUARY 1959	1958	% Diff.	Dec. 1958	STOCKS EAST OF CALIFORNIA Millions of Barrels End of Month — JANUARY 1959	1958	% Diff.	Dec. 1958
Crude Oil	259.7	284.5	— 8.7	262.9	220.9	241.3	— 8.5	223.6
Gasoline	198.0	207.1	— 4.4	186.2	171.5	178.3	— 3.8	160.8
Distillate Fuel Oil	95.4	122.4	—22.1	126.7	83.8	107.3	—21.9	114.1
Residual Fuel Oil	57.3	57.6	— 0.5	60.7	27.5	30.3	— 9.3	28.5
Kerosine	20.8	23.1	—10.0	26.1	20.5	22.7	— 9.7	25.7

Source: Except for latest two months, all data from U.S. Bureau of Mines. Data for last two months from American Petroleum Institute weekly reports and U.S. Bureau of Mines weekly crude stock report; except U.S. Natural Gas Liquids Production and Demand figures which are from WORLD OIL.

U. S. Crude Production by States
(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION — January 1959	1958	% Diff.	December 1958	TOTAL PRODUCTION — January 1959	1958	% Diff.
Alabama	15.7	15.3	+ 2.6	16.0	487	474	+ 2.7
Arkansas	80.8	83.1	— 2.8	82.8	2,505	2,577	— 2.8
California	849.6	921.0	— 7.8	854.7	26,337	28,551	— 7.8
Colorado	127.9	140.1	— 8.7	128.2	3,965	4,345	— 8.7
Florida	1.2	1.3	— 7.7	1.2	38	39	— 2.6
Illinois	225.1	235.6	— 4.5	225.6	6,977	7,303	— 4.5
Indiana	33.1	30.8	+ 7.5	32.7	1,025	955	+ 7.3
Kansas	312.9	335.5	— 6.7	324.7	9,699	10,400	— 6.7
Kentucky	63.4	41.5	+ 52.8	62.3	1,965	1,285	+ 52.9
Louisiana	937.3	846.3	+ 10.8	924.9	29,056	26,235	+ 10.8
North Louisiana	115.4	114.6	+ 0.7	114.2	3,577	3,551	+ 0.7
South Louisiana	821.9	731.7	+ 12.3	810.7	25,479	22,684	+ 12.3
Michigan	24.8	25.9	— 4.3	24.8	768	804	— 4.5
Mississippi	120.4	105.1	+ 14.6	119.6	3,733	3,258	+ 14.6
Missouri-Tennessee-South Dakota	0.4	0.5	— 20.0	0.3	11	16	— 31.3
Montana	78.7	74.7	+ 5.4	76.8	2,441	2,316	+ 5.4
Nebraska	59.2	54.6	+ 8.4	59.8	1,835	1,694	+ 8.3
Nevada-Washington	0.1	0.2	— 50.0	0.1	4	6	— 33.3
New Mexico	279.0	268.2	+ 4.0	279.6	8,650	8,314	+ 4.0
Southeast	248.7	262.3	— 5.2	250.2	7,711	8,131	— 5.2
Northwest	30.3	5.9	+413.6	29.4	939	184	+410.3
New York	5.1	6.9	— 26.1	4.6	157	214	— 26.6
North Dakota	37.0	37.1	— 0.3	38.9	1,147	1,150	— 0.3
Ohio	13.5	16.3	— 17.2	14.2	420	504	— 16.7
Oklahoma	548.1	568.6	— 3.6	552.1	16,990	17,626	— 3.6
Pennsylvania	15.1	19.6	— 23.0	16.0	467	608	— 23.2
Texas	2,849.2	2,727.5	+ 4.5	2,835.2	88,330	84,551	+ 4.5
Dist. 1: South Central	44.6	46.7	— 4.5	46.3	1,384	1,447	— 4.4
Dist. 2: Middle Gulf	128.0	128.8	— 0.6	129.6	3,969	3,992	— 0.6
Dist. 3: Upper Gulf	418.4	412.6	+ 1.4	414.5	12,970	12,792	+ 1.4
Dist. 4: Lower Gulf	204.9	203.9	+ 0.5	205.5	6,352	6,321	+ 0.5
Dist. 5: East Central	31.3	32.3	— 3.1	31.2	969	1,001	— 3.2
Dist. 6: Northeast	290.5	284.7	+ 2.0	287.8	9,007	8,827	+ 2.0
Dist. 7-B North Central	142.4	146.1	— 2.5	141.0	4,415	4,527	— 2.5
Dist. 7-C West Central	143.8	151.2	— 4.9	142.9	4,459	4,686	— 4.9
Dist. 8: West	1,128.7	1,017.8	+ 10.9	1,116.6	34,991	31,552	+ 10.9
Dist. 9: North	211.5	198.7	+ 6.4	216.9	6,557	6,160	+ 6.4
Dist. 10: Panhandle	105.1	104.7	+ 0.4	103.8	3,257	3,246	+ 0.3
Utah	101.1	15.2	+565.1	89.5	3,134	470	+566.8
Virginia	.....	.....	.....	.....	.....	.....	.....
West Virginia	5.8	5.8	.....	5.3	181	181	.....
Wyoming	332.5	306.1	+ 8.6	335.3	10,306	9,491	+ 8.6

SOURCE: Bureau of Mines and API. Texas districts from API and do not necessarily agree with state totals.

mained 7½ weeks until the end of March, during which further seasonal increases in gasoline stocks would be normal.

In these circumstances, there is a definite danger that the industry may have some trouble in keeping gasoline stocks within satisfactory limits. If the inventories should be expanded excessively, surplus gasoline could be expected to weaken prices just as the seasonal increase in demand begins.

The industry now is coming to the close of the season of peak consumption, which occurs in winter when heating oil use is greatest. It is approaching the spring and early summer months, when total petroleum consumption shrinks seasonally to the lowest levels of the year. In this period, heating oil use declines sharply and gasoline consumption is only beginning to rise toward its peak summer and fall levels.

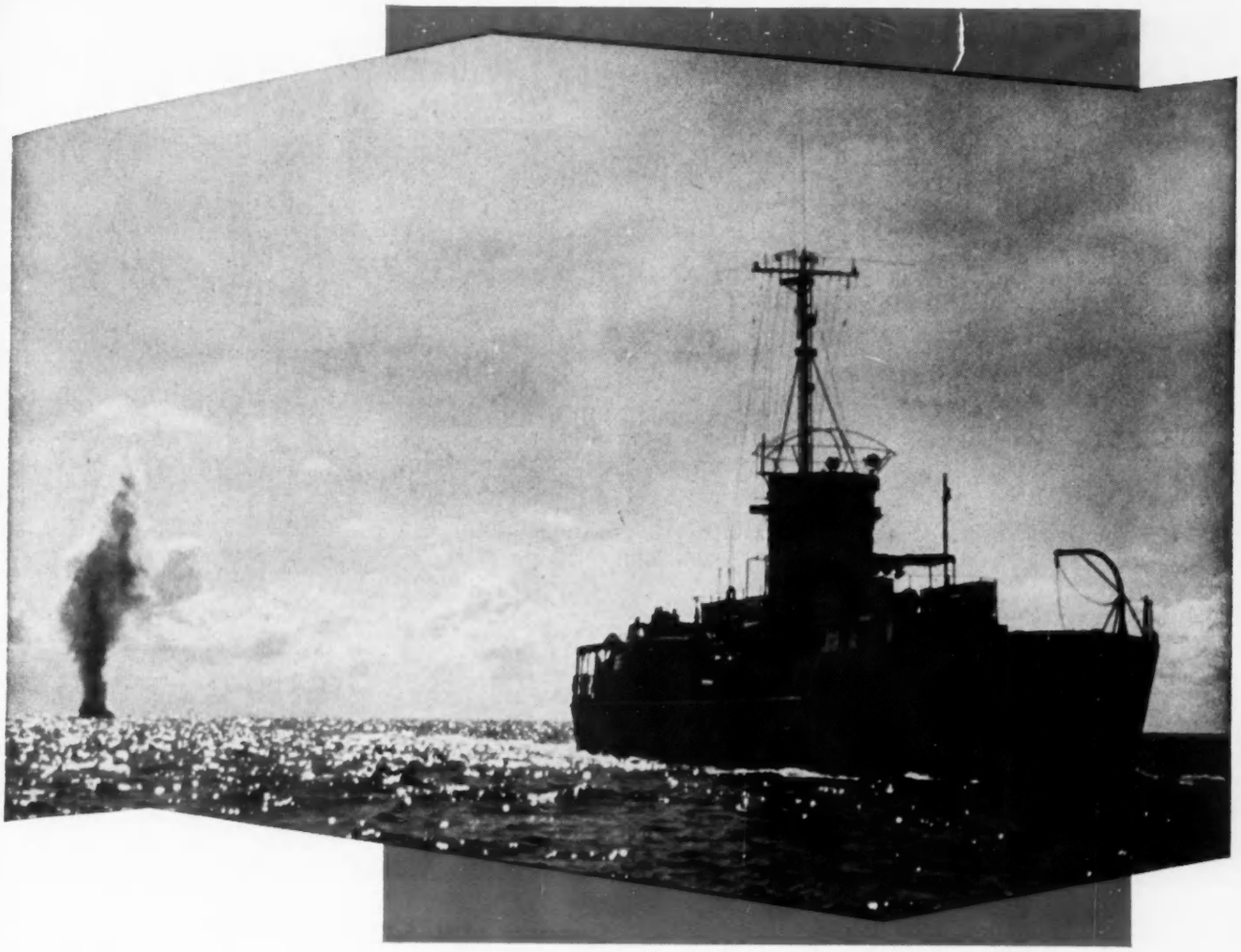
The next several months, therefore, will require careful watching of inventories of crude oil and refined products and wise adjustment of crude production and refinery runs, in line with prevailing and prospective market requirements.

Greatly affecting results in balancing supply and demand will be the trend of imports of crude and products. There is hope that imports will be held at reasonable levels, but it remains to be seen if this source of supply will be satisfactorily controlled.

The most encouraging factor in the petroleum industry outlook is the prospect of record breaking demand for oils in 1959. In the United States, total demand for all petroleum is expected to be 4 percent greater than in 1958. Exports probably will show a further small decrease, but domestic demand will be up 4.3 percent.

Both producers and refiners are expected to increase operations by somewhat greater amounts than the 4 percent increase in demand. That will be because refiners probably will make some net additions to stocks of products in 1959, boosting crude output and runs to stills above current demand. In contrast, crude production and refinery runs were curtailed below demand in 1958, as requirements were met in part by drawing on stocks of crude and products.

Demand for petroleum in free countries outside the United States is expected to show an increase of about 8 percent in 1959.



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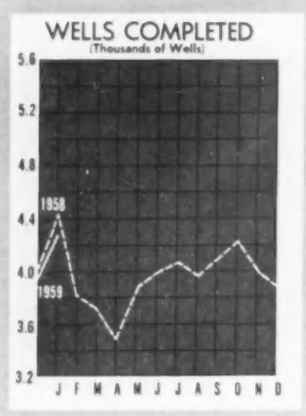
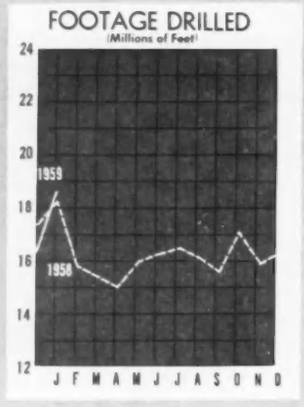
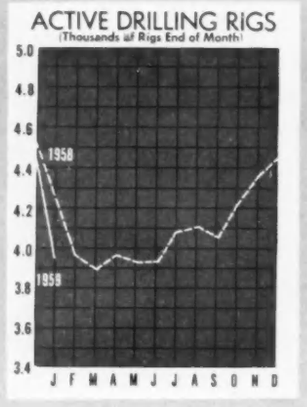
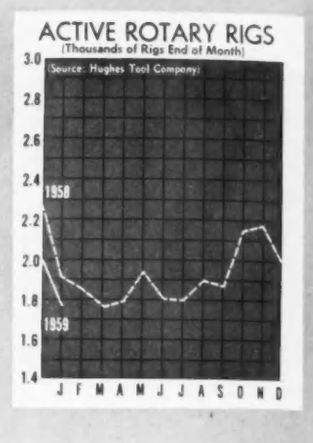
Drilling Activities...









January drilling down from year-ago levels

SEVERE WINTER weather combined with tight proration schedules to hold January new well completions 2.7 percent below the same period in 1958. Last month's new U. S. well completions totaled 4,287, a drop of 117 wells from the January, 1958 total.

However, the January total showed considerable improvement over December, with an increase of 328 wells or 8.3 percent.

Only 3,984 rigs were operating at the end of January, 461 less than December and 169 less than were reported on January 31, 1958. The recent shallow well drilling boom in Kentucky and increased activity in New Mexico kept the U. S. rig totals from dropping to even lower levels. Total rigs in Kentucky increased 42 rigs, from 95 operating on December 31 to 137 on January 31. New Mexico's rig total increased 14 to 168 rigs during the same period.

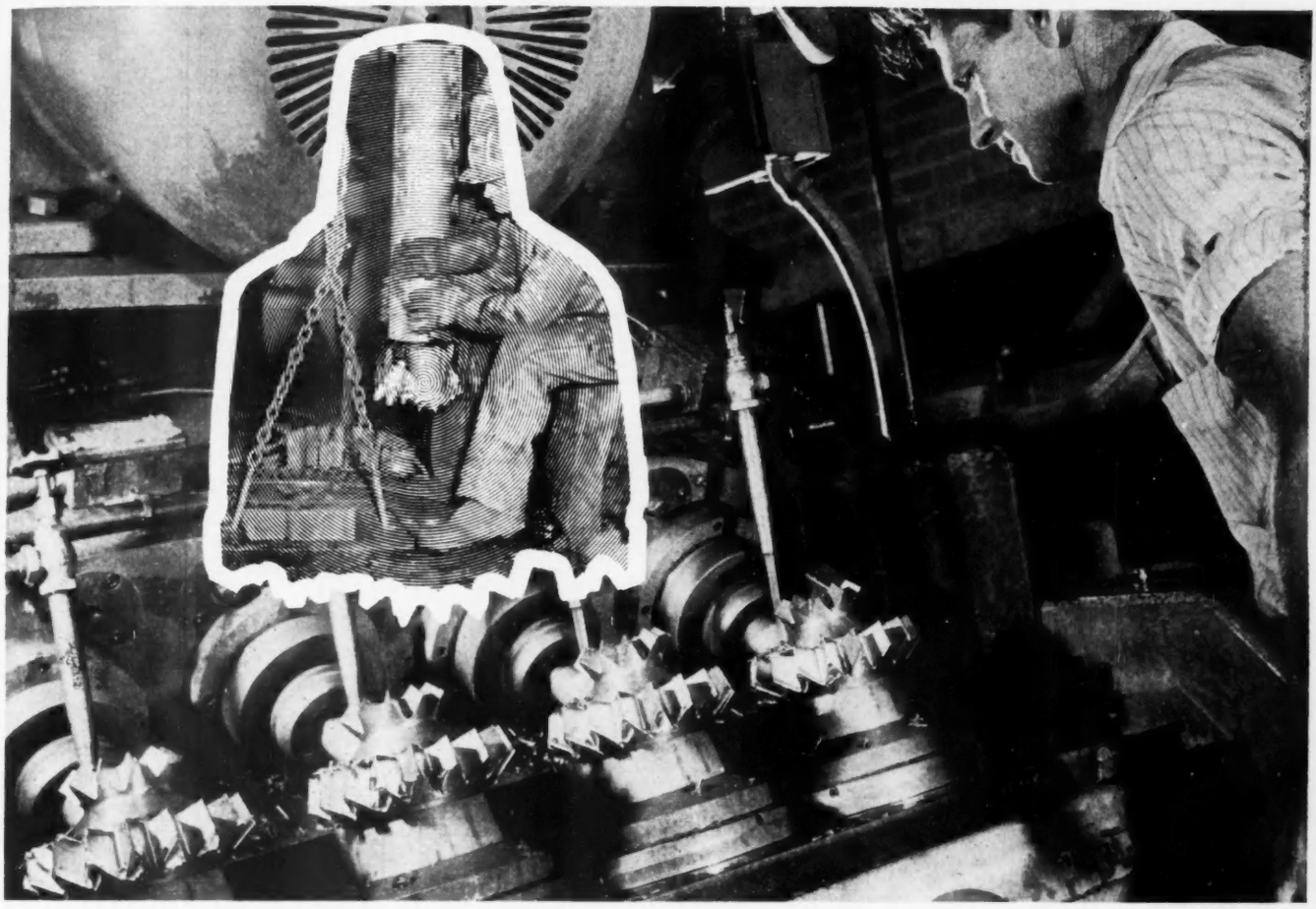
Operators drilled 18.5 million feet of hole in January, 2.3 million feet more than were drilled in December, and the same total as was drilled in January 1958.

Summary of U. S. Drilling Activity

ITEM	January 1959	December 1958	January 1958	% Diff. January 1959–1958
Oil	2,224	1,944	2,228	— 0.2
Distillate	75	43	61	+ 23.0
Gas	309	374	369	— 16.3
Service	73	93	110	— 33.6
Dry	1,606	1,505	1,636	— 1.8
Total Wells	**4,287**	**3,959**	**4,404**	**— 2.7**
Footage Drilled (Mln. of Feet)	**18.5**	**16.2**	**18.5**	....

Summary of U. S. Wildcat Drilling

ITEM	January 1959	December 1958	January 1958	% Diff. January 1959–1958
New Field Discoveries:				
Oil	68	65	67	+ 1.5
Distillate	10	..	3	+233.3
Gas	29	16	27	+ 7.4
Total Discoveries	**107**	**81**	**97**	**+ 10.3**
Dry Wildcats	798	727	807	— 1.1
Total Wildcats	**905**	**808**	**904**	**+ 0.1**
Percent Productive	11.8	10.0	10.7	....
Percent Dry	88.2	90.0	89.3	....



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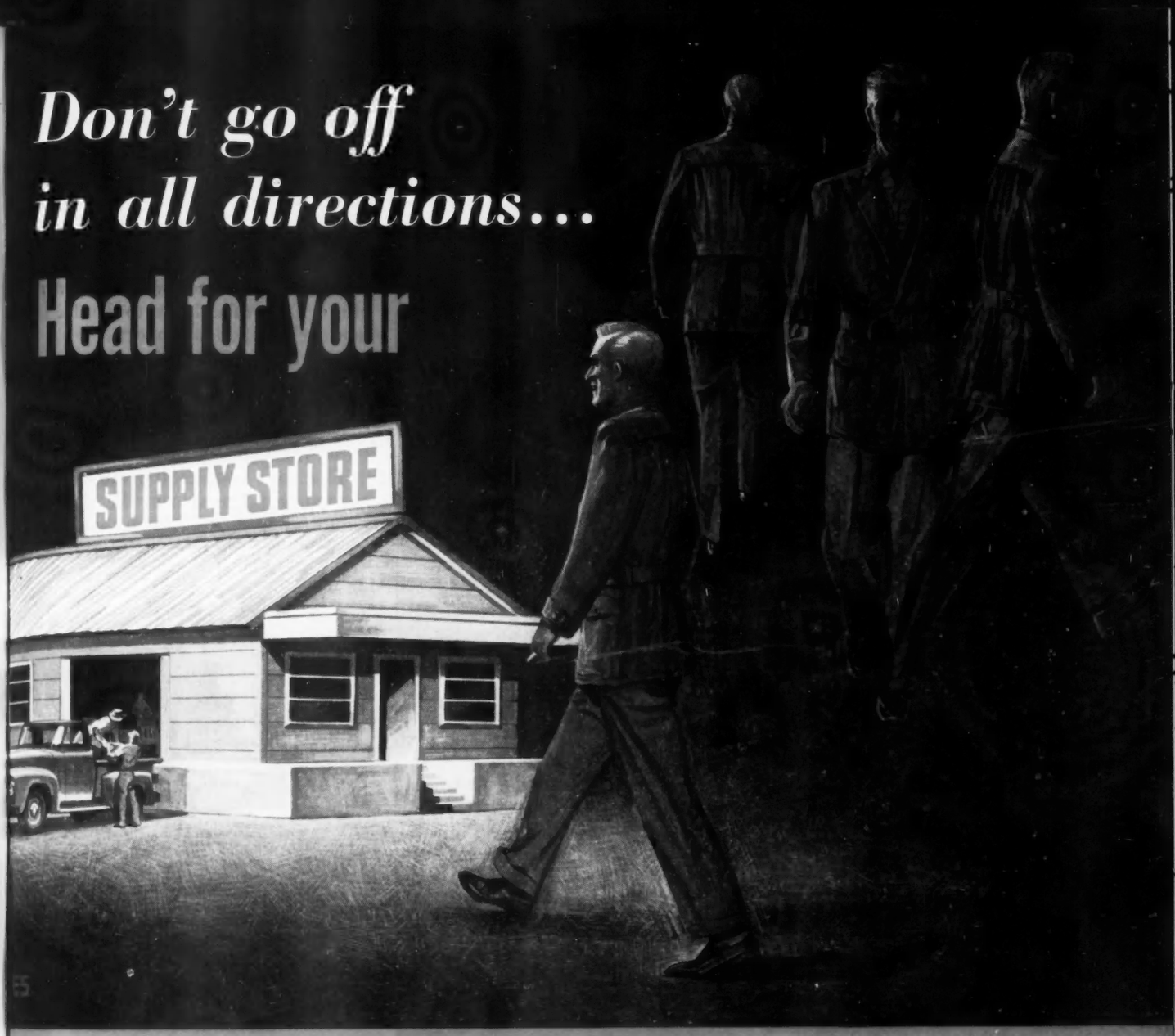
U. S. Drilling Activity in January Compared With Year Ago

STATE or DISTRICT	NEW WELLS COMPLETED AND FOOTAGE DRILLED: DETAILS FOR JANUARY: Oil	Dist.	Gas	Dry	Service Wells	TOTAL NEW WELLS: Jan. 1959	Dec. 1958	Jan. 1958	% Diff. January 1959-1958	TOTAL FOOTAGE: January 1959	January 1958	WILDCAT DRILLING JANUARY: NEW FIELDS IN JANUARY: Oil	Dist.	Gas	TOTAL DISCOVERIES: Jan. 1959	Dec. 1958	Jan. 1958	DRY WILDCATS: Jan. 1959	Dec. 1958	Jan. 1958	TOTAL WILDCAT TESTS: Jan. 1959	Dec. 1958	Jan. 1958	DRILLING RIGS IN OPERATION (Rigging Up, Drilling, Temp. Shut-Down): Jan. 31, 1959	Dec. 31, 1958	Jan. 31, 1958
Alabama	10	....	....	2	....	12	11	4	+200.0	122,598	39,723	....	....	....	....	....	....	1	6	2	1	6	2	17	15	11
Alaska	1	....	....	....	....	1	....	....	.....	12,046	.....	1	....	....	1	....	....	....	....	....	1	....	....	5	....	....
Arkansas	52	....	2	28	....	82	101	69	+ 18.8	255,711	209,250	1	....	....	1	1	1	11	19	9	12	20	10	41	52	44
California	82	....	6	34	....	122	129	181	— 32.6	556,531	774,449	....	....	4	4	1	1	23	32	24	27	33	25	135	156	160
Colorado	8	....	5	41	....	54	61	67	— 19.4	306,029	337,550	2	....	2	4	2	8	29	29	29	33	31	37	49	60	54
Florida	....	....	....	1	....	1	1	....	.....	4,748	.....	....	....	....	....	....	....	1	1	....	1	1	....	2	1	1
Georgia	....	....	....	....	....	....	....	....	.....	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....
Illinois	125	....	2	120	....	247	118	218	+ 13.3	547,950	490,135	....	....	....	....	....	1	58	34	53	58	34	54	249	294	240
Indiana	23	....	1	31	1	56	82	74	— 24.3	89,042	119,682	....	....	....	....	....	....	15	17	17	15	17	17	101	113	105
Kansas	159	....	15	151	2	327	344	296	+ 10.5	1,184,813	1,056,646	15	....	5	20	16	4	82	79	63	102	95	67	319	338	289
Kentucky	51	....	15	78	7	151	136	113	+ 33.6	205,689	173,043	1	....	....	1	....	2	12	2	8	13	2	10	137	95	84
Louisiana	180	23	34	126	....	363	304	317	+ 14.5	2,992,393	2,553,827	8	2	1	11	2	6	41	65	34	52	67	40	333	356	348
North Louisiana	60	1	9	41	....	111	121	107	+ 3.7	420,241	431,235	3	1	....	4	1	1	12	35	4	16	36	5	62	65	59
South Louisiana	120	22	25	85	....	252	183	210	+ 20.0	2,572,152	2,122,592	5	1	1	7	1	5	29	30	30	36	31	35	271	291	289
*Gulf of Mexico	36	4	4	12	....	56	36	45	+ 24.4	547,028	420,516	1	....	....	1	1	1	1	1	3	2	2	3	35	44	62
Michigan	9	....	5	25	....	39	36	24	+ 62.5	112,288	72,069	2	....	....	2	1	1	10	8	7	12	9	8	82	86	55
Mississippi	31	1	6	30	....	68	64	42	+ 61.9	614,831	352,419	4	....	....	4	2	2	24	18	19	28	20	21	63	75	44
Missouri	....	....	....	....	....	....	1	....	.....	.....	.....	....	....	....	....	1	....	....	....	....	....	1	....	....	....	....
Montana	15	....	....	12	....	27	25	38	— 29.0	128,303	226,767	....	....	....	....	2	5	6	8	14	6	10	19	36	39	36
Nebraska	17	....	....	28	....	45	58	47	— 4.3	232,859	289,842	3	....	....	3	2	4	15	28	16	18	30	20	32	30	22
New Mexico	79	....	18	19	....	116	141	254	— 54.3	500,382	1,151,561	3	....	....	3	2	11	16	13	30	19	15	41	168	154	170
Southeast	50	....	3	15	....	68	57	124	— 45.2	324,757	587,598	3	....	....	3	2	6	13	10	15	16	12	21	76	83	91
Northwest	29	....	15	4	....	48	84	130	— 63.1	175,625	563,963	....	....	....	....	....	5	3	3	15	3	3	20	92	71	79
New York	24	....	1	2	18	45	45	45	.....	53,400	53,400	....	....	....	....	....	....	....	....	....	....	....	....	42	42	42
North Dakota	23	....	....	13	....	36	23	31	+ 16.1	244,067	198,419	3	....	....	3	....	2	5	5	4	8	5	6	36	34	45
Ohio	42	....	21	10	....	73	82	88	— 17.1	203,210	233,956	1	....	....	1	....	....	....	3	2	1	3	2	195	228	226
Oklahoma	313	6	38	218	18	593	588	497	+ 19.3	2,074,213	1,772,184	7	....	5	12	9	8	75	58	47	87	67	55	465	529	610
Pennsylvania	15	....	29	5	6	55	78	52	+ 5.8	150,802	139,335	....	....	....	....	....	....	....	2	2	....	2	2	165	210	156
South Dakota	....	....	....	....	....	....	1	3	—100.0	.....	16,991	....	....	....	....	1	....	....	....	3	....	1	3	2	3	.....
Tennessee	....	....	1	4	....	5	5	5	.....	6,000	6,000	....	....	....	....	....	....	2	2	2	2	2	2	.....	.....	.....
Texas	905	45	79	558	20	1,607	1,343	1,748	— 8.1	7,192,920	7,455,058	14	8	8	30	36	39	331	265	379	361	301	418	1,000	1,181	1,050
Dist. 1: South Central	44	2	5	38	....	89	107	79	+ 12.7	244,190	227,584	1	....	....	1	....	3	25	19	25	26	19	28	35	36	32
Dist. 2: Middle Gulf	20	12	8	29	....	69	56	48	+ 43.8	432,766	303,125	2	1	2	5	....	4	20	20	8	25	20	12	48	52	38
Dist. 3: Upper Gulf	50	12	3	42	....	107	123	130	— 17.7	743,640	847,264	1	4	2	7	3	2	22	30	28	29	33	30	74	113	94
*Gulf of Mexico	....	....	....	....	....	....	....	....	.....	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1
Dist. 4: Lower Gulf-S.W.	31	16	7	59	....	113	98	95	+ 18.9	619,387	543,204	2	2	....	4	8	4	39	43	40	43	51	44	60	85	57
*Gulf of Mexico	....	....	....	....	....	....	....	....	.....	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Dist. 5: East Central	1	....	2	10	....	13	15	25	— 48.0	78,047	93,904	....	....	....	....	....	....	8	7	15	8	7	15	9	14	5
Dist. 6: Northeast	41	2	10	23	....	76	73	98	— 22.5	409,118	518,988	....	....	1	1	2	2	14	19	21	15	21	23	56	58	46
Dist. 7-B: North Central	88	....	2	113	1	204	152	217	— 6.0	684,395	708,527	1	....	1	2	7	4	67	45	67	69	52	71	85	84	97
Dist. 7-C: West Central	32	....	1	24	....	57	41	91	— 37.4	243,672	448,960	1	....	....	1	2	2	18	11	26	19	13	28	53	68	70
Dist. 8: West	373	....	4	85	8	470	354	397	+ 18.4	2,326,681	1,855,763	3	....	1	4	11	6	59	30	48	63	41	54	324	387	314
Dist. 9: North	157	....	16	116	11	300	248	448	— 33.0	886,152	1,316,152	1	....	....	1	....	9	49	40	85	50	40	94	169	189	184
Dist. 10: Panhandle	68	1	21	19	....	109	76	120	— 9.2	524,872	591,587	2	1	1	4	3	3	10	1	16	14	4	19	87	95	113
Utah	17	....	....	17	....	34	25	40	— 15.0	205,190	228,555	....	....	1	1	....	....	14	9	7	15	9	7	36	36	60
Washington	....	....	....	....	....	....	1	1	—100.0	.....	8,400	....	....	....	....	....	....	....	1	1	....	1	1	.....	1	.....
West Virginia	20	....	27	10	1	58	73	70	— 17.2	138,500	187,200	....	....	....	....	....	....	....	....	....	....	....	....	174	219	210
Wyoming	23	....	4	43	....	70	74	79	— 11.4	360,684	319,518	3	....	3	6	3	2	27	20	34	33	23	36	96	93	77
Others	....	....	....	....	....	.....	9	1	—100.0	.....	590	....	....	....	....	....	....	....	3	1	....	3	1	3	4	8
Total United States	2,224	75	309	1,606	73	4,287	3,959	4,404	— 2.3	18,495,199	18,466,569	68	10	29	107	81	97	798	727	807	905	808	904	3,984	4,445	4,153
Total Western Canada	130	....	15	60	5	210	238	209	+ 0.5	1,050,000	1,052,031	....	....	....	....	....	....	....	....	....	....	....	....	1,781	243	211

*Gulf of Mexico wells are included in their respective district total.



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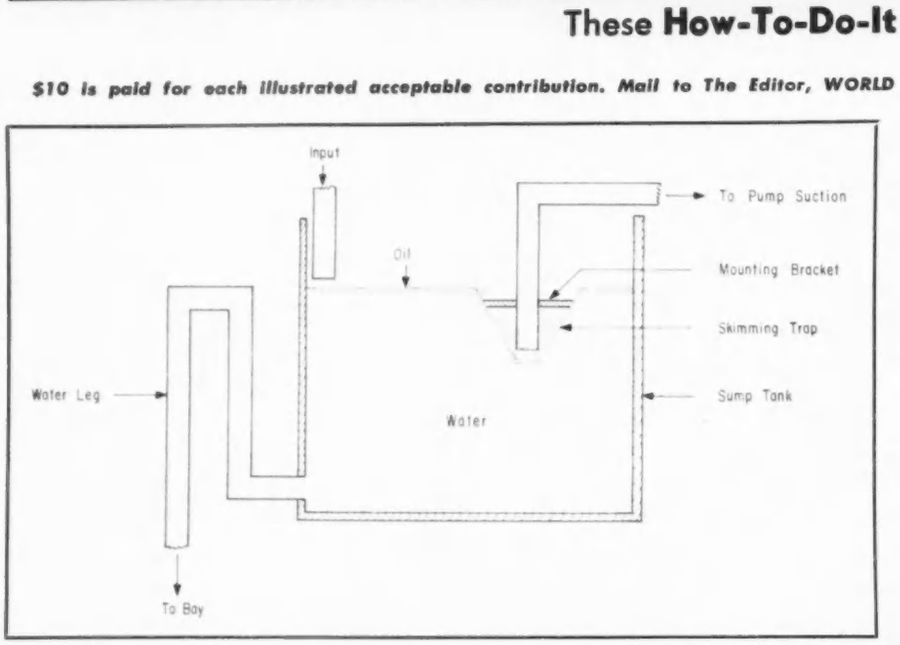
Practical Operating Hints

These **How-To-Do-It** Ideas Can Save You Money

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas



Mounted Skimming Trap Prevents Oil Pollution

Sump tanks are used for salt water disposal in many over-water oil fields. The presence of oil in the sump tanks is highly undesirable since salt water usually is dumped from the sump tanks directly into the marsh or bay. It is almost impossible to prevent some quantity of oil from reaching these sump installations since salt water is discharged directly from heater treaters or gun barrels.

The oil trap shown in the schematic drawing and photograph is an efficient method of recovering this sump tank oil. The skimming trap proper is mounted on the 4-inch pump suction shown, by mounting brackets.

The trap is positioned just below the highest expected liquid level in the sump tank. When a quantity of oil has collected on the surface of the sump tank fluid, the pump is started. Oil is pulled into the trap and is pumped back to storage. By alternately pumping and closing the water leg discharge from the sump into the bay most of the oil can be quickly and easily recovered thus preventing any oil from polluting the bay.

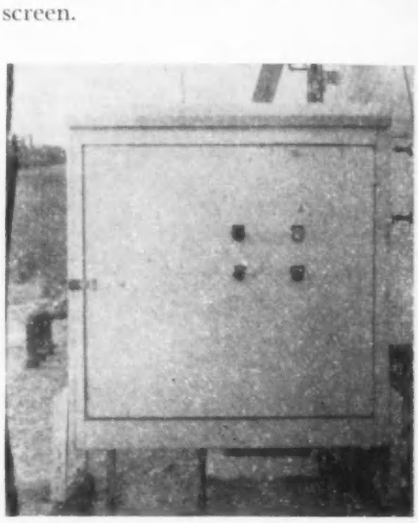
Build Mud Materials Rack on Shaker Housing

Adding mud materials at the shaker screen can be a problem because of no way to steady a can of caustic soda or no place to put a sack of thinner. One Gulf Coast operator has solved this problem by building a rack with an angle iron frame covered with metal matting.

The rack is welded to the shaker housing so that the platform is flush with the top of the housing. Pieces of angle iron welded to the outer corners of the platform and then to the shaker housing give added support.

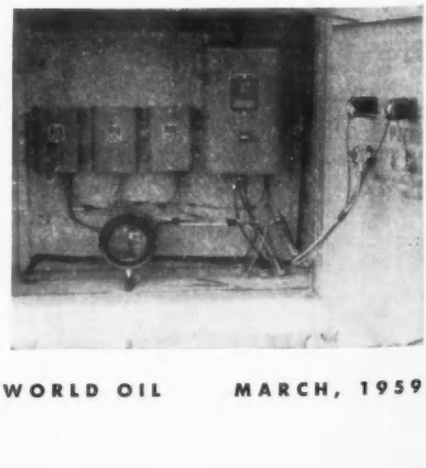
The identical pieces of metal are welded to the front and back of the frame. These pieces of sheet iron are shaped so that when a drum is placed on its side across them, it cannot roll.

This rack enables the mud to be treated as it flows from the flowline and before it flows through the shaker screen.



Install Automatic Control In Surplus Meter House

These two photographs show the installation in a surplus meter house of the electrical automatic control components for a water flood system. This method for housing electrical control items is applicable to automatic tank switching systems, automatic well testers, LACT systems, etc. The method offers several advantages



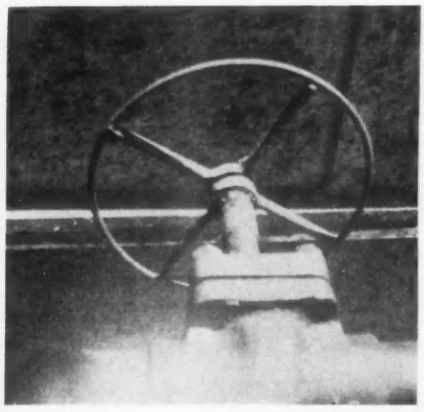
over pole mounted installations. These advantages are:

1. All electrical components may be "open" or in "general purpose" enclosures (as shown) instead of in more expensive water tight enclosures required for pole installations.

2. Interconnecting circuits may be exposed instead of installed in conduit. The installation therefore is much faster and cheaper and circuits are more easily traced and modified.

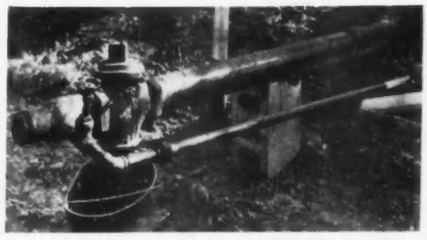
3. Switches and indicating lights may be mounted directly in the door instead of in a special enclosure.

4. Service and inspection are facilitated by the roomy interior of the house and the wide opening doors. The wooden bottom affords a convenient shelf for meters and tools during construction.



Ring Welded to Valve Prevents Accidents

Safety is always of prime importance. Here is a drilling contractor who has welded a ring around a mud system valve handle. By having this ring on the valve handle, the danger of anyone walking into the handle and injuring themselves is minimized.



Prevent Oil Leakage With Return Line

When oil is transported by truck from field tank batteries, which are not provided with direct pipe line connections, a connection such as the one illustrated is advantageous.

The 4-inch line shown is tied directly into the "pipe line-run" valves on each stock tank. The tank truck which moves the oil to market ties a hose directly to the 4-inch x 3-inch swage nipple shown. The truck then is filled with crude.

After the truck is filled, the hose is disconnected from the swage and returned to its position on the truck. During this operation the quantity of oil remaining in the hose spills on the ground (when the hose is disconnected). This creates a fire hazard and leaves an unsightly loading point. To alleviate the spillage problem, the installation shown was developed by one lease operator. A 1-inch line with valve is welded to the 4 x 3 swage. The 1-inch valve is closed during loading operations.

When the truck is full and the hose ready to be disconnected, the 4-inch valve is closed and the 1-inch valve opened. This allows the oil retained in the hose to drain through the 1-inch line into an oil sump located safely within the battery firewall. The loading hose then can be safely disconnected from the swage without spilling any oil on the ground.

Safety Chain Connects Pressure Line Couplers

This device was installed on a steam line where a well known sleeve-type coupler was used to connect 2 lengths of pipe. Just to make sure the two pieces of pipe would not pull apart, a hook was welded to each length of pipe near the junction. Then after the sleeve was in place and secured, a piece of chain was fastened tightly across the sleeve by hooking each end of the chain in a hook.

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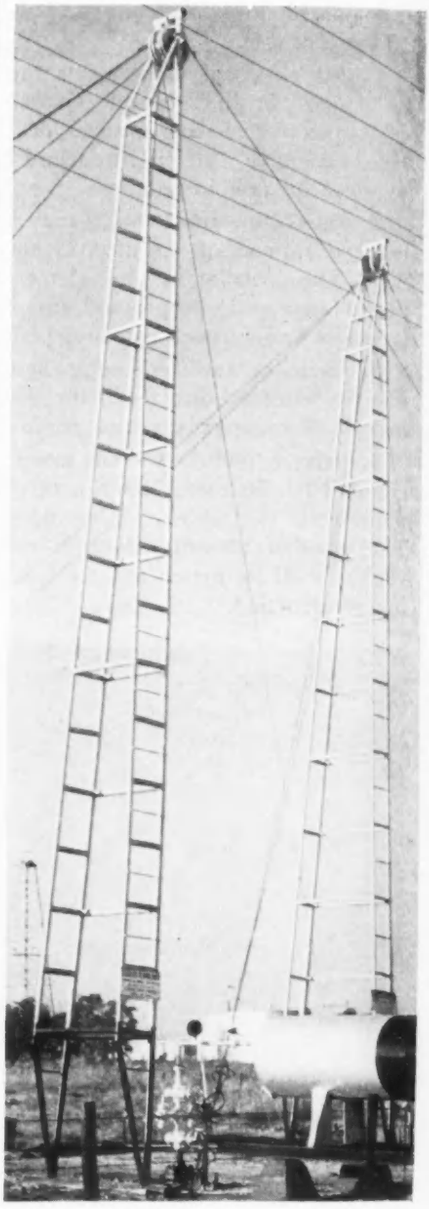
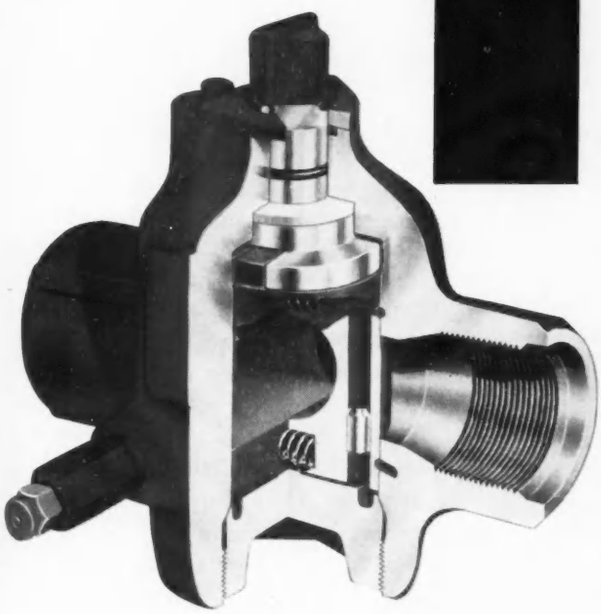


Permanent Gin Pole Made from Scrap Pipe

This operator has put a large quantity of scrap tubing to excellent use. Since many of the wells on this lease require clean-out and workover jobs fairly often, derricks frequently were required on location. To keep from moving complete rigs each time a minor clean-out job was required, this operator constructed permanent masts on each location. Scrap tubing was used throughout. Each mast is firmly anchored and is equipped with a single horizontal piece of 4-inch pipe for a base. If required the mast can easily be layed down. The masts have proved to be entirely successful. Welded throughout, the masts are economical to construct and are entirely ample for tubing jobs.



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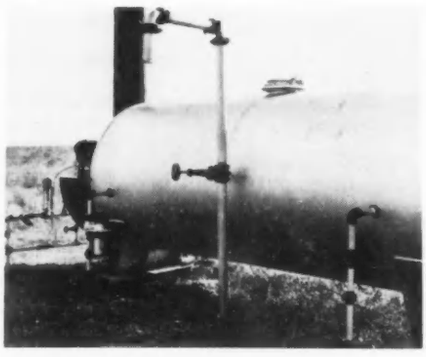
Junk Pipe Is Excellent Valve Guard

In many fields there are numerous valves located in widely separated, open areas. If livestock graze on the lease, there is always the danger that a valve may be inadvertantly opened or closed by the stock. In many cases, this could be disastrous if personnel were repairing a line etc. To eliminate this hazard, valve guards are installed over all valves located in open areas or areas not within the confines of a tank battery fence.

The valve guard shown is easily and quickly constructed and installed. The four supporting legs are constructed of junk 2½-inch line pipe or tubing and driven into the ground far enough to obtain desired rigidity. The top portion is constructed of junk 2-inch line pipe as shown. Four short pieces of 2-inch pipe are welded on each corner vertical to the plane of the top portion. These short pieces then are inserted into the legs, and the top portion is in place. A vertical lift is all that is required to remove the top section if a valve requires repair or change-out.



Permanent Water Line Fills Lease Line Heaters

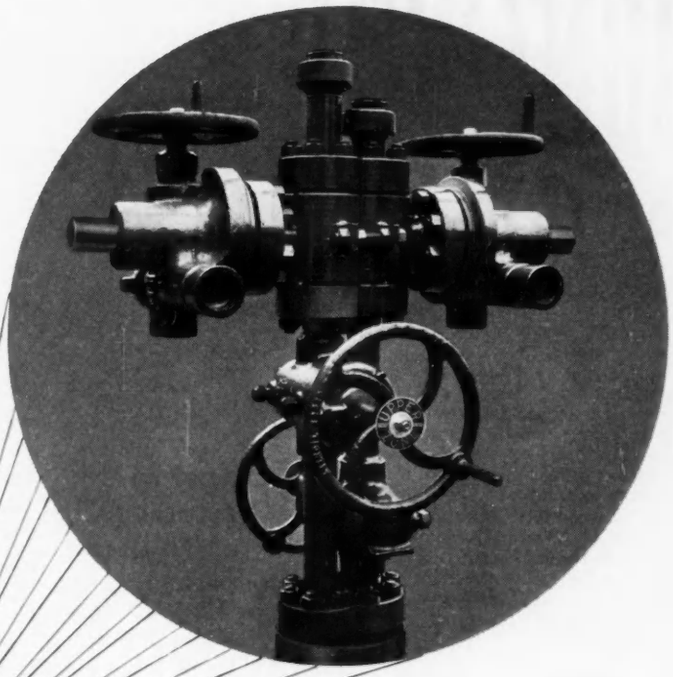
Here is a unique arrangement which is applicable in any field which has a fresh water system.

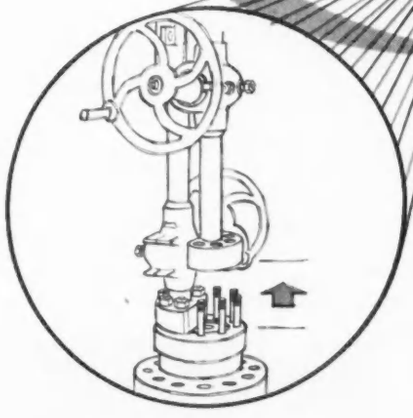
Since indirect fired line heaters sometimes require frequent filling with fresh water, this presents field personnel with somewhat of a problem if a single man is present on the lease.

Unless a small portable pump is available, the heater has to be filled by means of a bucket of water at a time. This is a safety hazard and is most awkward for one man to perform. Since this scene is from a field which possessed a water system, the unique filling arrangement shown was installed.

The vertical riser with the movable top section is tied into a field water well which is jetted with gas. When the heater requires water, the top portion of the fill line is swung over the fill hatch. By opening the gate valve water is directed into the heater shell with a minimum of time and effort.

O·C·T CRESCENT FLANGE





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106

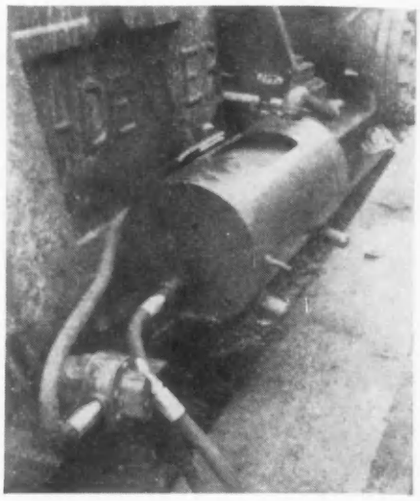
Sheet Metal Enclosure Protects Derrickman

Where winter weather is not severe enough to enclose the rig completely, some operators provide protection for the derrickman by enclosing three sides of the monkey board with sheet metal fitted together to form a compact structure. The sheets fit in lengths of channel iron bolted to the outer edges of the monkey board. The windbreaker is fastened with lengths of wire to the railing around the monkey board and at the corners and at each end.

Reach Buried Valves With Long Valve Wrench

There are numerous valves which are buried below ground level within tank batteries. Since some of these valves must be operated frequently, it is sometimes awkward to manipulate them with a conventional valve or pipe wrench.

This long reach valve wrench was constructed to reach buried plug valves with a minimum of time and effort. The handle and stem of the wrench are made from discarded sucker rods. The lower portion is cut from discarded steel plate. A minimum of welding time is required to construct the wrench which is an excellent time-saving tool.



Make Lubricator Tank From Scrap Casing

A Canadian contractor has devised a rod lubricator tank. It is made from a scrap of 10 3/8-inch or similar casing. The ends are welded up on a piece of desired length with fittings necessary to accommodate the section return.

The square door is cut in the top and then a hinge is welded on to prevent washdown water from entering the lubricating fluid. The entire assembly can be fabricated so that it can be bolted to the pump base.

Adjustable Outlet Drains Fire Wall

Here is a unique method of maintaining a constant liquid level within a tank battery firewall. The 4-inch pipe arrangement shown can be used to "set" the liquid level within the firewall without the danger of draining oil into the field or pasture. The

INTERPRETATION

Chinese writing or chicken tracks? It takes a chicken or a Chinaman to decide. That's the way it is with many oil well logs—difficult to decide if you have a well unless you're an expert. **But you don't have to be an expert to read a Welex log.** Welex's new interpretation techniques are designed to help you, the oil man, make your own decision with confidence. This is another reason why Welex, originator of jet perforating, now leads in revealing down-hole secrets of your well.

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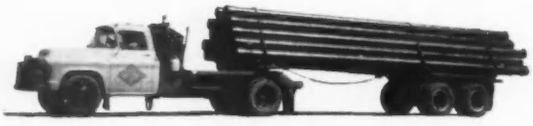

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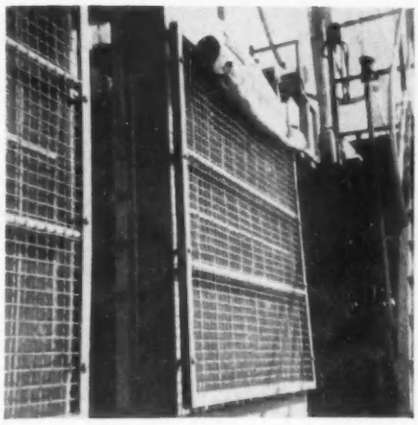
horizontal section of pipe passes through the firewall and into a sump. The upright portion of the pipe may be pushed up or down until a desired liquid level is obtained.

If a heavy rain occurs and the battery fills with water and oil is present, the drain is positioned so that most of the water drains off. When the level gets to the preset point, no more liquid is discharged, and the oil is safely retained in the firewall.

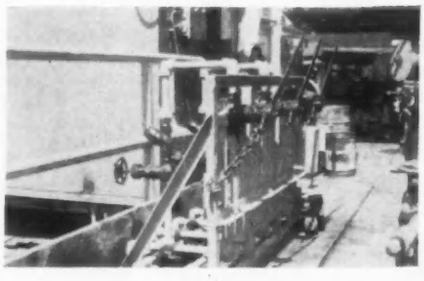
By setting the upright portion in a vertical position, drainage is stopped completely. Moving it to the horizontal position allows all of the liquid to drain from the battery.



Use Radiator Warm-Up Apron in Cold Weather

A simple canvas windbreaker will keep the radiator from cooling circulating water too much in extreme cold and insure proper motor operating efficiency.

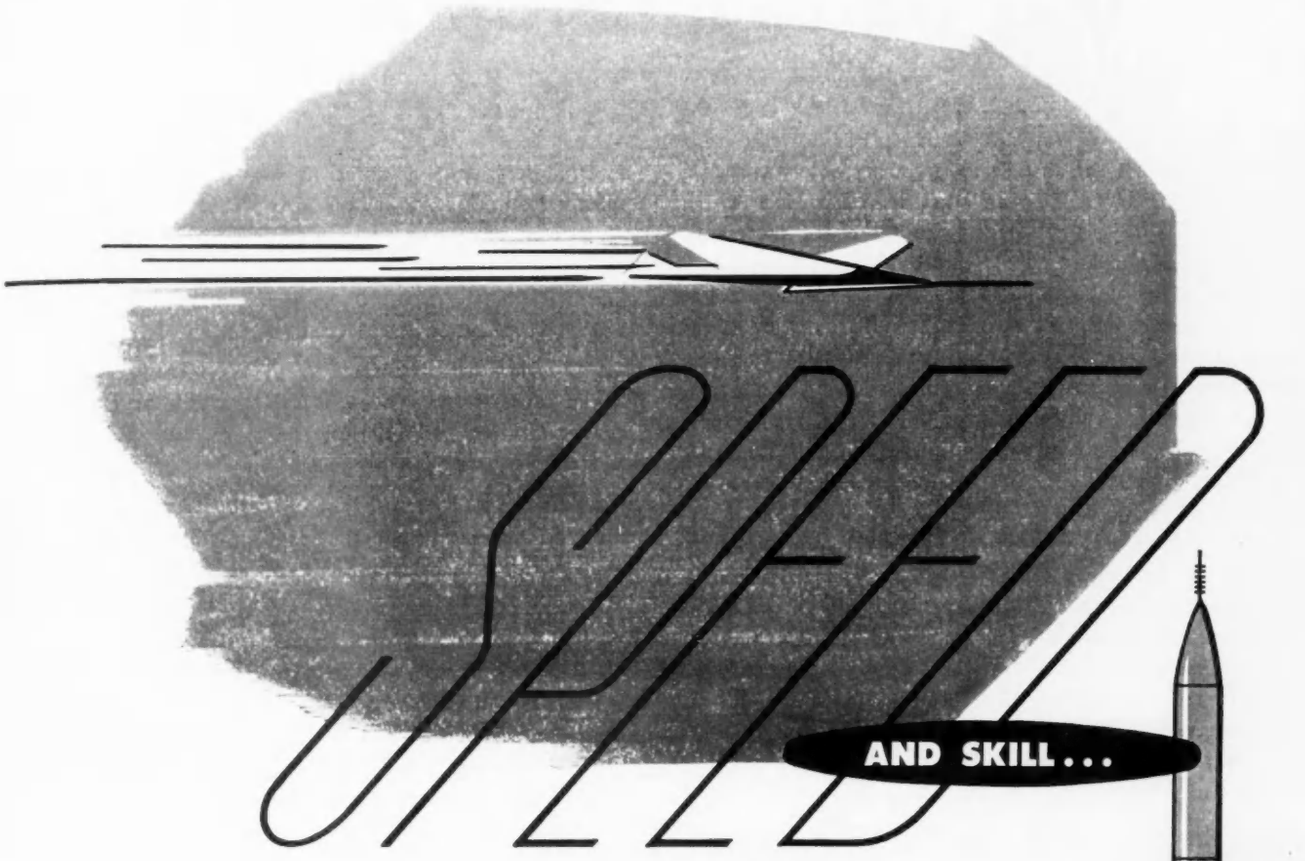
The illustrated windbreaker can be rolled up or let down according to the temperature. It is sized to fit the dimensions of the radiator proper.



Safety Chain Protects BOP Manifold Valve

A safety chain on valve on the BOP manifold guards against accidental closing of the valve which would cause severe cutting of the drill string or damage to the BOP.

This chain must be removed before the valves can be closed.



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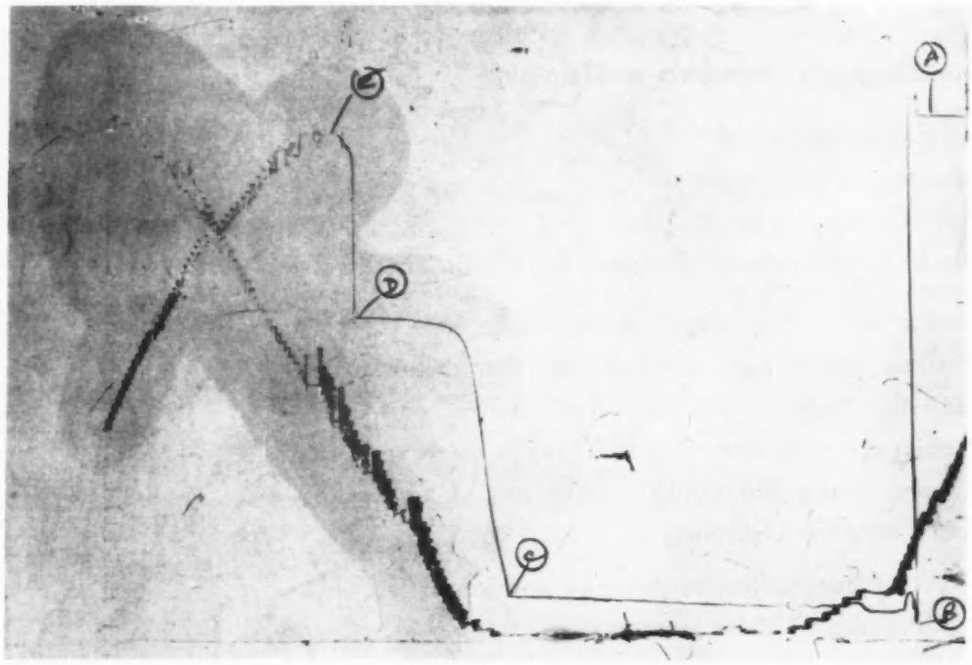
168 Barrels Of Oil A Day From A Dry Hole

This is the story of how an apparent dry hole was made a 168 bopd producer. The well was drilled by Mr. A. C. Torgeson of Torgeson Oils, Inc. who realized a successful producer from a wildcat well that could easily have been abandoned. The well was spudded in Weld County, Colorado, and was projected for the "J" sand around 6900 ft. The sand, when reached, was cored and an electric log was run. These revealed conclusively that the "J" sand was unproductive . . . that it contained only water. Had it not been for the alertness of the consulting geologist on the well, Paul "Skipper" Keller, the well would have been plugged and abandoned. Keller, however, had noticed an oil show in the cuttings from the "D" sand approximately 100 feet up the hole. The "D" sand was generally unproductive in the area and a thorough study of all available evidence indicated that it probably would be unproductive in this well even though there was a show in the cuttings. Normally a well of this type would have been abandoned immediately, but Mr. Keller was reluctant to do this in spite of the seemingly overwhelming odds against making a successful producer. The decision was then made to run a drill stem test in order to evaluate all the available information. The result was a producer!!!

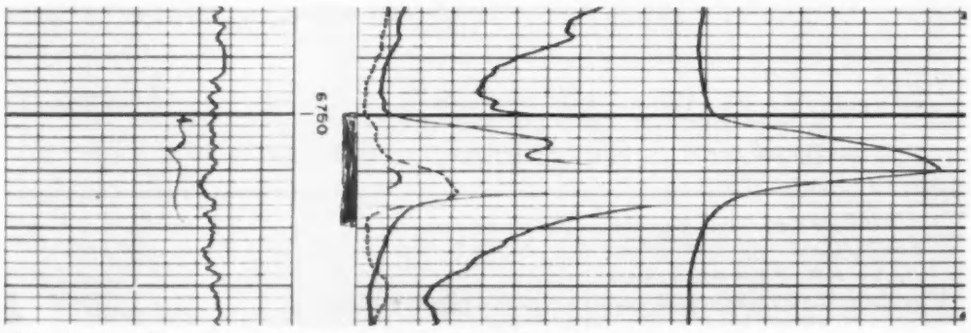
To obtain the test information which resulted in a positive decision to complete the well, Johnston Testers was called in from the Fort Morgan office and a straddle test was run. On the basis of the drill stem test, casing was set and the well perforated from 6758 to 6764 ft. The initial flow of the well was 168 bopd through a 30/64" choke. No well stimulation treatment was required and a dry hole became a producer.

This is an excellent example of the necessity of gathering and evaluating all the data possible before setting casing on a well that might be dry, or before abandoning a possible producer.

This well clearly demonstrates that it is unwise to discount any possible pay or write-off any well prematurely. It also demonstrates that Drill Stem Testing pays off in handsome dividends. The cost of a drill stem test is very small compared to the investment made in the drilling of the well. Test—to be absolutely sure.



Drill Stem Test chart for the Torgeson State No. 1. Tool was open for two hours with forty-five min. shut-in. Gas to surface in 18 min. (800,000 cu. ft.) and a good blow was observed. 550 ft. of oil and 270 ft. of oil and gas cut mud were recovered. No water was present. Initial flow (B) was 108 psi and final flow (C) was 291 psi. Final shut-in pressure (D) was 2221 psi.



Log showing SP and Resistivity curves at perforated interval.

JOHNSTON
DRILL STEM TESTING
TESTERS

Here's how to pump a triple completion

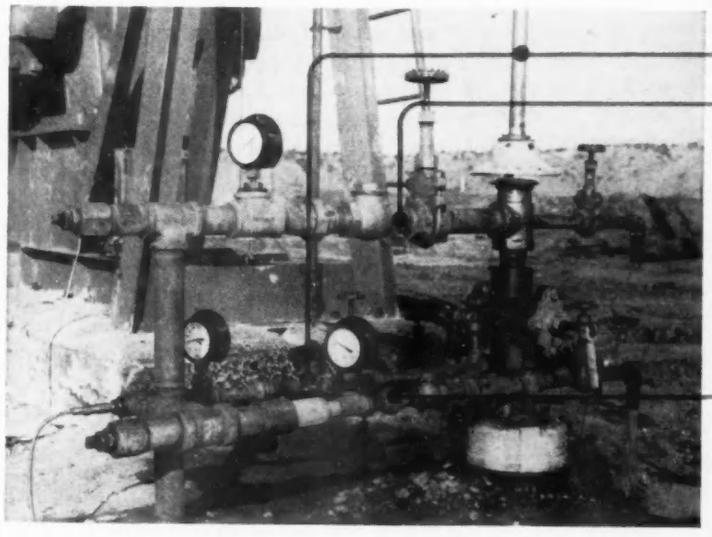
Three tandem rod pumps run on a single hollow rod string successfully lift this 3-zone producer. Production is not commingled in the hole and installations are applicable to wells equipped with 5½-inch casing

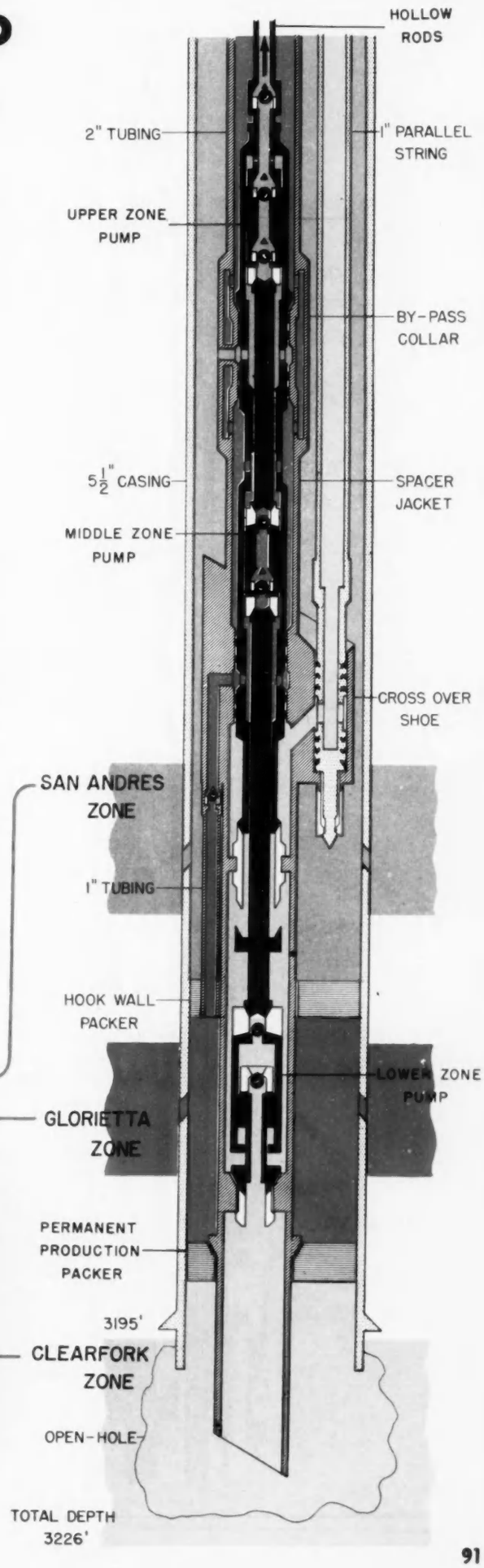
By David N. Newby, Production Superintendent
Richard S. Anderson, Oil Operator, Midland, Texas
J. A. St. John, Manager, Technical Service Division
Fluid Packed Pump Company, Odessa, Texas

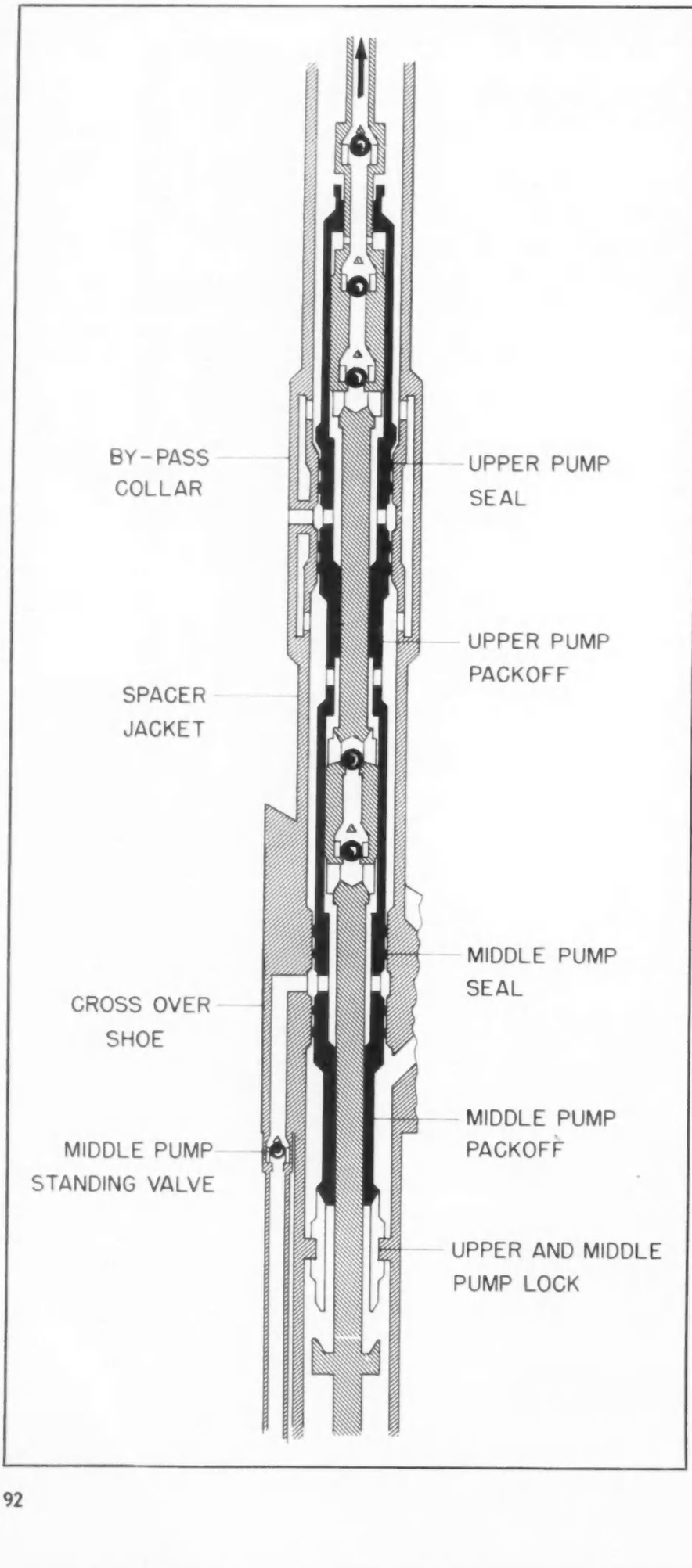
THE FIRST triple pumping well in the oil industry recently was completed by Midland oil operator Richard S. Anderson in the Rocker "A" Field, Garza County, Texas. Unique features of the installation are:

- Three insert pumps are run in tandem on a single string of hollow sucker rods.
- A string of 1-inch production tubing is run and seated in a cross-over shoe independent of the main 2-inch tubing string. The 1-inch serves as a conduit for fluid from one producing zone.
- All pumps are actuated by a single pump jack at the surface.
- Two packers were used to separate the three producing zones and all equipment was run through 5½-inch casing.
- In applicable areas, the procedure is very attractive, economically.

FIGURE 1—Schematic diagram (no scale) of the down-hole equipment arrangement in the triple pumper. Arrows indicate fluid paths from each zone. Note that all pumps are actuated by the single hollow rod string. Photo shows well head equipment used to complete the triple pumper. All zones are commingled into a common flow line on the surface.







The well currently is producing satisfactorily from the following zones:

San Andres—2,437-78 feet (perforated)

Glorieta—3,013-48 feet (perforated)

Clearfork—3,195-3226 feet (open hole completion)

The San Andres pay was discovered in the Rocker "A" field in 1950. The Glorieta was discovered five years later, and in 1957, was dually completed in three wells with the San Andres. In April, 1958, the Clearfork pay was discovered and since has been dualed either with the San Andres or Glorieta in five wells. Since all three pays are good commercial producers it was decided to attempt a completion to pump all three zones from one well bore. The Railroad Commission granted approval for the project and the well was completed successfully as a triple pumper. A second triple has been completed recently and work started on another.

The initial well, Stanolind Stoker 6, was drilled with rotary to a total depth of 3,195 feet and 5½-inch casing set on top of the Clearfork at that depth. The Clearfork then was drilled in with reverse circulation tools to a depth of 3,226 feet. The San Andres pay was perforated from 2,437 to 2,478 feet, and the Glorieta from 3,013 to 3,084 feet.

The well was treated and tested to insure commercial production from each of the three zones. A permanent production packer was set on wire line at 3,193 feet. Two-inch tubing then was run with equipment as shown in Figure 1. The hookwall packer (215 feet above the permanent production packer) has a gas vent in the top which is connected to a crossover by a short string of 1-inch tubing. This string serves as the conductor to supply fluid to the middle pump which lifts the Glorieta zone located between the two packers.

The spacer jacket screwed in the top of the crossover provides a set interval between the upper and middle pump seats. One of the difficulties of a tandem pump installation is to seat the pumps simultaneously. The

FIGURE 2—Construction details of the middle and upper pumps are shown in this schematic drawing. The pumps are built as a single unit and will seat as one pump when installed in the well.

spacer jacket successfully pre-spaces the upper and middle pump seats. The upper and middle pumps are built together so that when seated, they seat as one pump. These two pumps actually are built as one unit with two working barrels, two pump intakes, two hold-downs and a pack-off between the pumps to separate the fluid (Figure #2).

The bypass collar located on top of the spacer jacket provides a fluid intake for the top pump. It also provides a bypass around the top pump seat for the middle zone fluid moving up the two inch tubing from below. The tubing string was landed by tagging the permanent production packer, picking up 46 inches (the hookwall packer has a 36 inch setting stroke), and setting back down 46 inches. This placed 10 inches of weight, or about 8,000 pounds on the hookwall packer and insured that weight was not being placed on the low production packer. The tubing was screwed into a dual type tubing hanger and landed in the tubing head at the surface. A string of one inch tubing equipped with a seal nipple on bottom then was run and seated in the crossover. This was run through the dual head and hung in slips in the tubing head after landing.

The three insert pumps were run after landing the one inch tubing. The lower pump is connected to the middle pump by ¾-inch sucker rods. This section of rods has been measured previously to insure that the lower pump seats together with the two upper pumps. The measurement was made when the tubing string first was being run. Just before the crossover was added to the tubing string, the lower pump was run on the ¾-inch rods and seated in the lower pump seat. From this measurement a spacer rod was cut to complete the exact interval between the lower and middle pumps. This string of rods and the pump then were pulled from the tubing and the remainder of the tubing string run.

The middle and upper pumps are connected by a polished rod and packing gland. Seven-eighths inch hollow sucker rods with slim hole couplings were screwed in the top pump and run to the surface. Lower zone fluid is pumped through the two inch tubing to the crossover where it "crosses over" to the 1-inch tubing and is carried to the surface (Figure 1). The middle zone fluid is picked up through the gas vent in the hookwall packer, moves through the short string of 1-inch tubing to the crossover where it enters the 2-inch tubing. The middle zone pump which is seated in the crossover then pumps this fluid around the top pump intake through the bypass collar, and on to the surface. The upper zone fluid is picked up through ports in the bypass collar by the top pump and moves upward through the hollow sucker rods to the surface. Separation of the fluid in the 2-inch tubing is provided by two seal assemblies that are integral parts of the upper and middle pumps. These assemblies are screwed on the bottom of the pumps and employ seal rings and a polished rod to effect separation. For details of the tandem pump assembly, see Figure 3.

The well is being pumped with a beam type pump jack which has a 9,000-pound beam rating and a 40,000 inch-pound gear box. A 10-hp electric motor supplies power. A flexible hose is used to transfer the San Andres fluid from the top of the hollow polished rod to a one inch standpipe which is connected to the flow line. Two back-pressure valves are used to control paraffin and production in the Glorieta and Clearfork strings.

A summary of the treatment program used before completion follows:

- The Clearfork zone was completed in open hole from 3,195 to 3,226 feet with a pumping potential of 122 bopd and no water.

- The Glorieta was perforated 3,013-16 feet, 3,063-66 feet, 3,067-70 feet, 3,071-76 feet and 3,077-84 feet. Glorieta perforations 3,063-84 feet were acidized with 500 gallons of low tension acid, followed by 4,000 gallons of retarded acid. Glorieta perforations 3,010-16 feet were opened up with 500 gallons of low tension acid, followed by 2,000 gallons of retarded acid. Straddle packers were used in these treatments to isolate perforations. The Glorieta zone potentialed on the pump at 111 bopd and 8 bwpd.

- The San Andres was perforated

Continued on Page 97

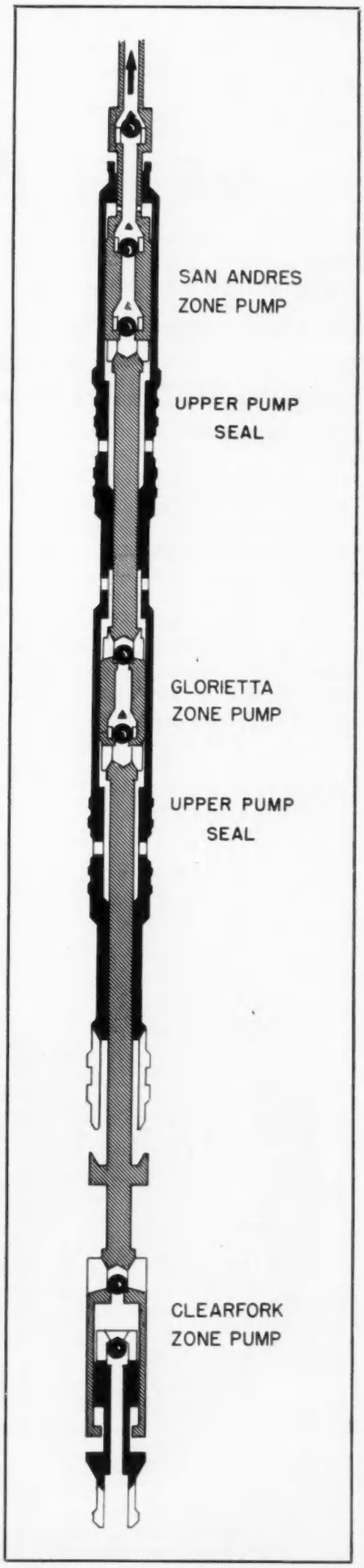


FIGURE 3—Complete pump assembly as it appears when run. Pumps are run on the single rod string and are seated simultaneously.

Will drilling increase in Western

The answer may well be "yes." Even though few test wells in this promising region have been drilled on the basis of geologic-seismic mapping, several have encountered oil and gas shows

By Dr. Robert R. Wheeler, General Manager
Pyramid Oil and Gas Corporation, Dallas

ONE OF THE less publicized potential oil and gas provinces in the Mid-Continent centers in the northeastern corner of New Mexico extending along the boundaries of the Texas and Oklahoma Panhandles northward many miles into Colorado.

In this region of several thousand square miles, comprising the western border of the Anadarko Basin, the early Pennsylvanian, Morrow, and older reservoir sections wedge out above pre-Cambrian basement averaging 4,500 feet in depth within a strongly folded and faulted structural belt where encouraging oil and gas shows have been encountered in test wells.

Although the region has not been ignored (Pure, Huber, Continental, Skelly and others have conducted exploratory programs), not even one well per hundred square miles has been drilled to date. Several were drilled west of the belt of early Paleozoic wedge-out possibilities in nonmarine Permian terrane overlying basement. Few of these were drilled on the basis of geologic-seismic mapping that would be standard procedure in oil country. This is another case of disinterest, where a potential province is remote from surrounding district geologists' activity, as suggested by Figure 1.

On the other hand, exploration and drilling have been progressing steadily from Oklahoma westward toward this Anadarko Basin border indicating that the region will receive considerable attention in the future. (The Bureau of Mines is currently much concerned with waste of helium reserves in this gas area and will propose a multimillion dollar subsidy to guarantee helium for a vastly expanded market including rocket fuel).

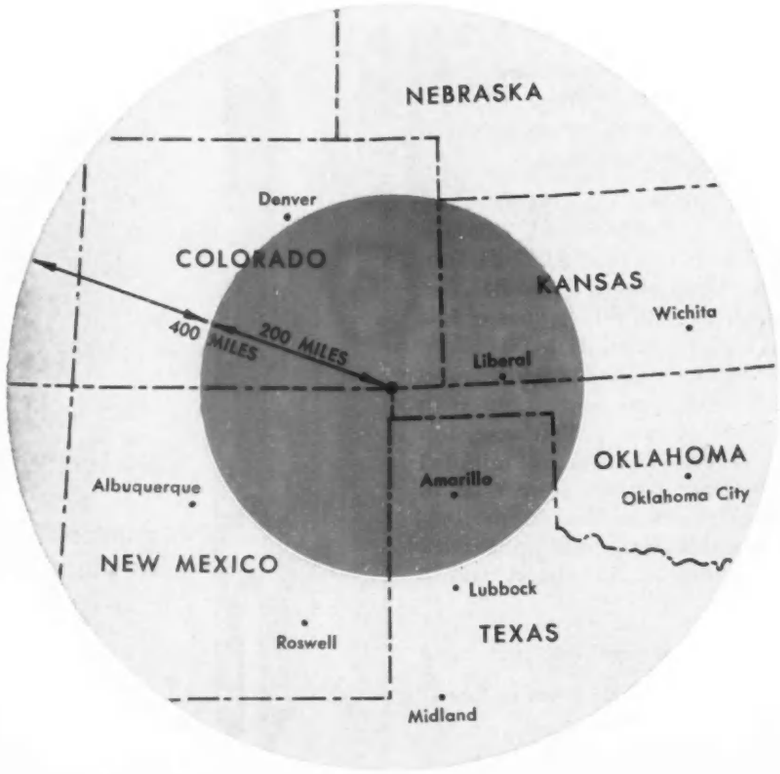


FIGURE 1—Map showing remote position of Western Basin border from surrounding district geological headquarters.

Unique features. In contrast to the Pennsylvania sands that constitute the main objectives of the extremely active drilling program across northwestern Oklahoma and bordering Kansas and Texas, the main prospects along the western border are Mississippian and Arbuckle dolomitic limestones.

Also, the western border shows a unique structural history involving large scale folding and faulting which suggests that local accumulation may be associated with structural traps rather than the lensing sands and permeability traps that typify the region to the east. Other differences of considerable economic interest are the

Anadarko border area?

much shallower depths and far thicker reservoir sections in this western border.

Prerequisites for accumulation. Most geologists would agree that the three requirements[1] for oil and gas accumulation are amply in evidence in this region. These are indications of structural and/or stratigraphic traps, the presence of reasonably thick porous and widespread reservoir rocks and associated shows of oil and gas or source beds.

A far less easily evaluated factor is the time association between migration and the creation of traps. Specific data fulfilling these general requirements will be outlined in the following paragraphs.

Regional geology. Many years ago, following an effort by this writer to deliver a pioneer lecture on regional geology and oil prospects of the Anadarko Basin,[2] that inquiring old pro, Claude Barrow (Oil Editor, *Daily Oklahoman*) posed the embarrassing question, "Where is the western border of the basin?" Nobody had the faintest idea at that time.

Various ideas have been expressed since, but it seems to be generally agreed that the Sierra Grande uplift of northeastern New Mexico separates the Anadarko from the Raton Basin to the west.

On trend with this uplift, in southeastern Colorado, the Las Animas Arch separates the Anadarko from the Denver-Julesburg Basin insofar as regional arching involves a great deal of Paleozoic convergence with primarily Cretaceous oil prospects to the west. There is rarely a sharp definition between basins and bordering uplifts.

Probably, the best demarkation of the western border of the Anadarko Basin is the sub-crop belt in which the older Paleozoic rocks wedge out and beyond which Permian arkosic, predominately non-marine clastics directly overlie pre-Cambrian basement. By this definition, the border is identified along truncated arches subsidiary to the east of the main Sierra Grande axis in northeastern New Mexico and southeastern Colorado.

Deformation. Major structural features consist of a north-south trending belt of large scale faulting and at least one high relief arch parallel to and east of the bordering Sierra Grande uplift (see Figure 2).

The fault zone was first defined as

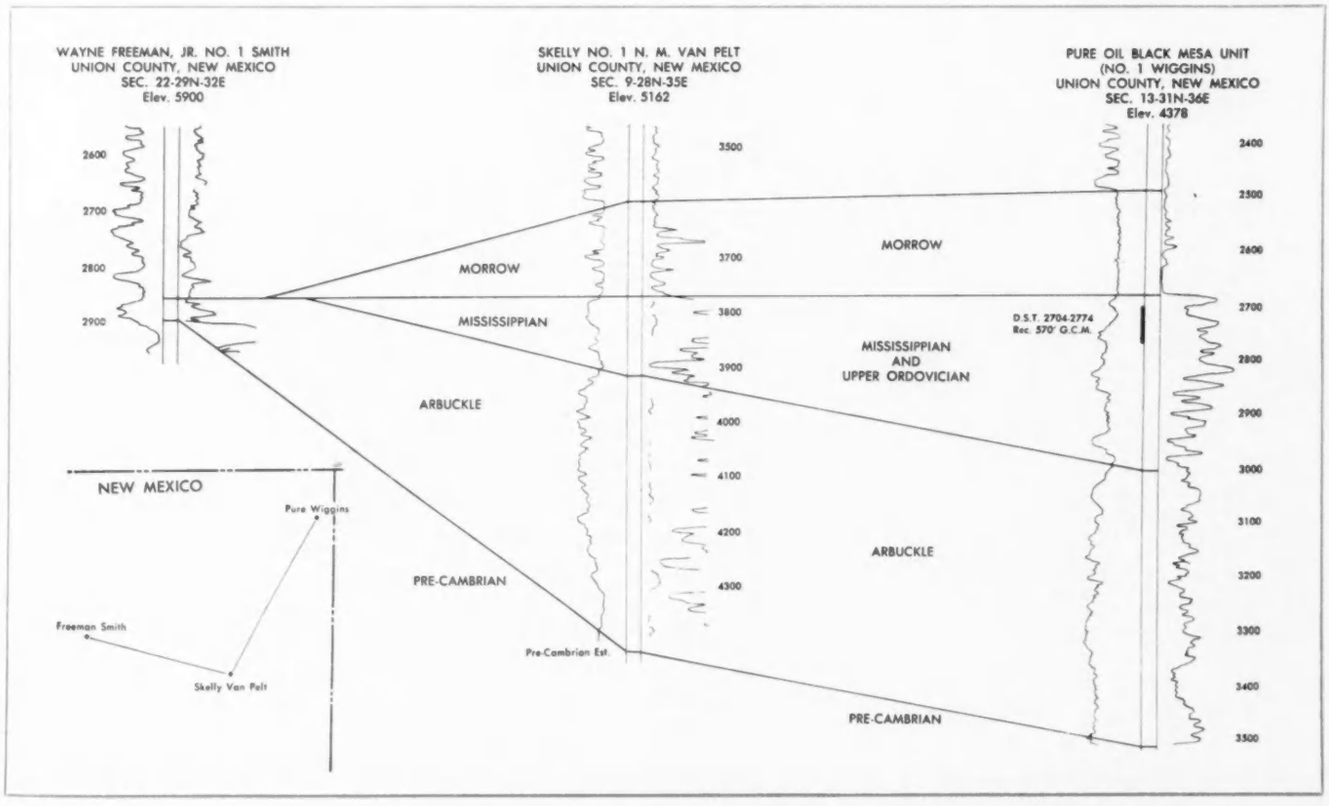


FIGURE 2—Western Anadarko Basin border. Structural and subsurface map. 1,000-foot contours on pre-Cambrian.

the Freezeout Creek fault by Buehler in 1947.[3] In this excellent geological report, all of the stratigraphic units were described and a convincing case made for the existence of one or more faults of early to middle Pennsylvanian age with displacements approaching 2,000 feet. Judging from cross-sections, the movement was primarily post Morrow, early Pennsylvanian in age.

Further structural discrepencies, amounting to hundreds of feet in the Morrow and older rocks, occur in the northeastern corner of New Mexico. They strongly suggest that the Freezeout Creek belt of faulting extends south. The displacements are also known to extend far north of Freezeout Creek. These movements evidently occurred contemporaneously with the main episode of Arbuckle-Wichita-Amarillo mountain building that differentiated the Anadarko Basin from the Southern Oklahoma Embayment[4] of the Ouachita geosyncline in post-Morrow pre-Des Moines time.

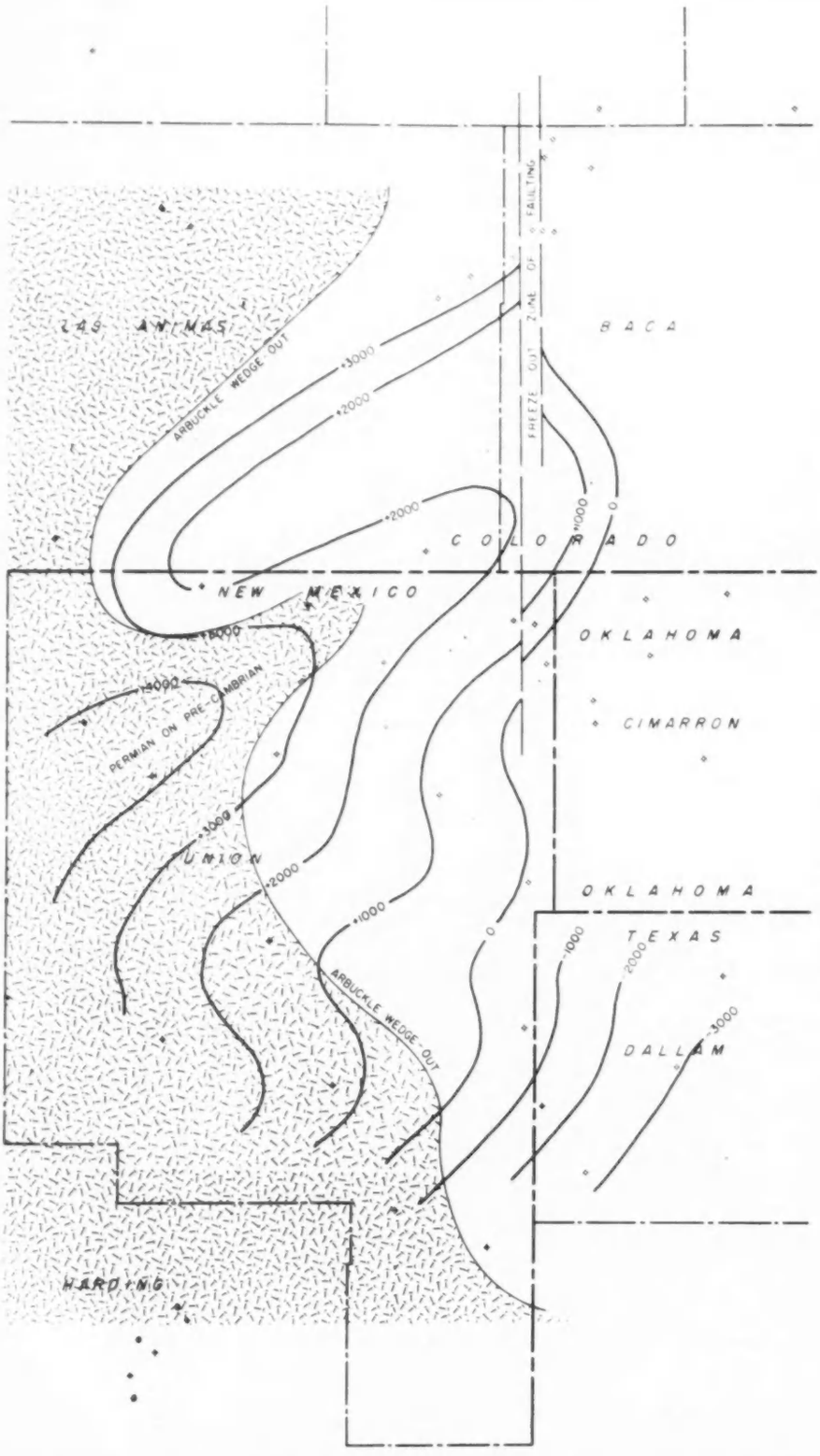


FIGURE 3—Stratigraphic Section. Northeastern Union County, New Mexico. Showing westward convergence of Morrow, Mississippian and Arbuckle.

The most prominent upwarp in the border region is a deeply truncated arch of some 2,000 feet of structural relief trending north-eastward out of Union County into southeastern Las Animas County, Colorado. The subsurface control suggests that the higher parts of this arch are baldheaded with Permian clastics lying directly on the pre-Cambrian.

Angular unconformities between the flat-lying Jurassic sandstone and tilted Triassic redbeds, observed[5] in the Dry Cimarron Valley of northern Union County indicate that structural movements continued at least into early Mesozoic time. Structural studies[6] made to determine the attitude of the Dakota sandstone aquifer indicate considerable warping and a very substantial regional tilt at the base of the Dakota in northeastern Union County. Early surface mapping and airphoto studies show prominent northwest trending fold axes, e. g., Guy monocline in north central Union County and Clapham or Tate anticline twenty miles southwest of Clayton.

Buehler notes that a monoclinal fold overlies the Freezeout Creek fault zone in Baca County. Probably other folds in the region overlie subsurface faults. They may have accompanied Tertiary movements that initiated volcanism. Finally, Tertiary extrusives and volcanic necks within and abundantly to the west of this area involved structural disturbances continuing into nearly Recent time.

In view of the foregoing tectonic evidence, it seems probable that seismic exploration will reveal folded and faulted prospects for drilling. This situation might be contrasted with the central portions of the Anadarko Basin in which there is little local folding or faulting with a consequent scarcity of structural and convergence traps.

Reservoir objectives. A few hundred feet of Mesozoic continental sediments cover much of the region locally capped by basaltic lava, "malpais." This and the underlying nonmarine arkosic Permian are not regarded as likely objectives although the latter produces carbon dioxide to the west.

The early Pennsylvanian Morrow may develop local porous sand lenses with oil and gas possibilities. However, it appears that the main objectives of exploration in the area will be the dolomitic Mississippian and Arbuckle limestones. Electric log characteristics and testing data show that this sequence is porous and fluid-bearing as shown in Figure 3.

The Arbuckle thins from some 500 feet in northeastern Union County to its wedge-out on the previously mentioned arch. Likewise, the Mississippian thins from a little over 300 feet westward to its pinch-out.

A minor part of the section assigned to the Arbuckle may be dolomitized Viola or Simpson. In any case, by analogy to the northern flank of the basin (the central Kansas uplift), it appears that these Ordovician rocks have been chemically altered with improved porosity since much of the pre-Mississippian section preserved in central areas of the Anadarko Basin is missing due to non-deposition and erosion with consequent exposure and leaching. Similarly, the upper Mississippian, including the Chester, is missing and the truncated section has been dolomitized prior to overlap by the Morrow.

Possibilities of accumulation. Drillstem tests were made on scattered wells in the region. These indicate general permeability. Several wells have tested gas-cut mud and others have tested modest to large volumes of salt water in the Mississippian.

Three wells drilled in the northeastern corner of New Mexico (Pure Wiggins 1 Pure, Black Mesa 2, and Atkinson Quimby 1) tested oil and gas-cut mud or water (2,252 feet salt water in 30 minutes).

Assuming the southward continuation of the Freezeout Creek fault system into easternmost Union County, the Atkinson test would be on the updip (wedge-out) side of the fault zone. The fact that it preserved nearly as thick a development as the downthrown block of Mississippian and Arbuckle and tested gas-cut mud in the Mississippian would lead one to believe that gas and/or oil migrated on west to the wedge-out which is a thousand feet structurally higher.

Conclusion. All the prerequisites for oil and gas accumulation can be demonstrated to exist along the western border of the Anadarko Basin and the fact that the region has been only locally tested by modern exploration techniques and wells makes it currently attractive with the probability of increased attention in the near future.

ACKNOWLEDGMENT

The writer wishes to acknowledge the assistance in this geological investigation of Norman C. Smith, photo consultant, and Philip Oetking, independent geologist, both of Dallas. Thanks are also due R. W. Foster, New Mexico Bureau of Mines and Mineral Resources, for subsurface data.

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About the Author

Dr. Robert R. Wheeler, Dallas, manages the Mid-Continent operations of the Pyramid Oil & Gas Corp. Following his doctorate from Harvard in 1942, he worked for oil companies, and as a geological consultant specializing in oil possibilities of the Anadarko Basin and Mid-Continent in general. In 1953, Wheeler published "The Structural Map of Oklahoma," a unique individual contribution to the subsurface study of an active oil region. More recently, he co-authored "Oil —From Prospect to Pipeline," an explanation of oil operations for the layman.

Triple Completion

Continued from Page 93

2,447-52 feet and 2,472-78 feet. Both sets of perforations were straddled in a single treatment using 1,000 gallons of low tension acid to break the formation. This was swabbed back and followed with 9,000 gallons of retarded acid staged three times with 400 pounds of crushed moth balls per stage. The San Andres potentialed on the pump at 86 bopd and 16 bwpd.

The final test of any piece of equipment engineered to a new process, is time. The triple pumper only has been operating a short while and final analysis of the practicality of the installation will have to wait. If it proves to be successful in lifting triple completions in the long run, considerable economic advantages will be realized. **—The End**

About the Authors

Newby **St. John**

David N. Newby was graduated from Oklahoma University in 1943, with a B.S. degree in petroleum engineering. He served three years with the Army Engineering Corps and after being discharged joined Phillips Petroleum Company as an engineer trainee. He worked three years for Phillips and resigned in 1949 to buy and operate a ranch in Hobbs, N. M. Newby returned to the oil business in 1956 when he was employed by Richard S. Anderson, Midland oil operator. He now resides in Post, Texas, and supervises Anderson's Garza County oil operations.

Jeff A. St. John joined Fluid Packed Pump Company in August of 1950 as a district sales representative at Breckenridge, Texas. Prior to joining Fluid Packed, St. John had gained wide experience in the oil industry, having served in various capacities in both drilling and production. He was transferred from a regular sales and service assignment to Fluid Packed Pump Company's newly organized Technical Service division in May, 1953. He was promoted to technical service supervisor in 1957 working out of Tulsa, and was made manager of the Technical Service division in November, 1958, with headquarters at Odessa, Texas.

Unique program combats external tubing corrosion in California

Timed, automatic inhibitor injection, improved completion techniques provide economical solution to deposit attack corrosion problem

By P. W. Hill, Engineer, and
H. J. Kipps, Technical Service Engineer
Signal Oil and Gas Company
Long Beach, Calif.

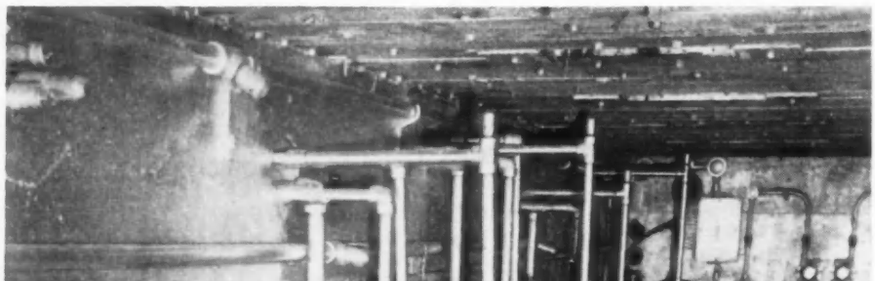
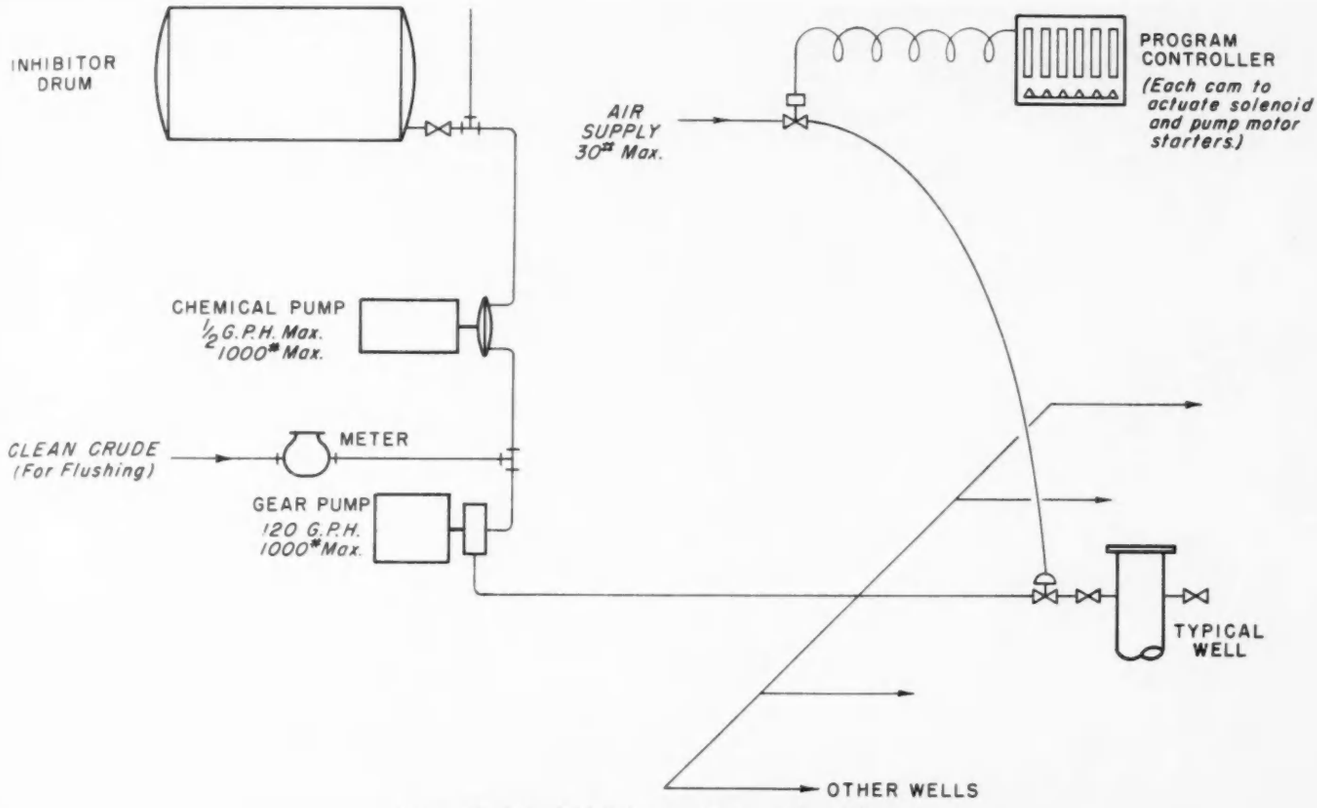


FIGURE 1—This view shows typical well spacing and arrangement of corrosion control equipment in the Redondo Beach area of California. Since all wells are grouped closely together, a common, automatic inhibitor injection system is used for treatment purposes.

AN UNUSUAL and costly corrosion problem in the annulus of directionally-drilled wells is being controlled economically and successfully by Signal Oil and Gas Company in the Redondo Beach, California, area. Corrosion control measures include: (1) changing well completion practices; (2) plastic coating the exterior surface of tubing strings; and (3) injection of inhibitors, using an automatically controlled chemical-wash oil injection system, which protects uncoated equipment in the wells.

Crude production potential was proven on the City of Redondo Beach (California) leases with a group of six exploratory wells drilled and completed during March-December 1956. A period of ten months followed while a drill site was created on the ocean edge for some 24 additional development wells. During this period, problems relating to oil production were studied, including the possibility of corrosion attack on down-hole equipment. Gas produced through the annuli of these wells proved to contain up to 17 percent carbon dioxide, and from 3 to 60 grains per hundred cubic feet of hydrogen sulfide. The combination of these gases and formation brine generally promotes serious corrosion attack. To evaluate this possibility, the latest methods of corrosion rate measurements were employed. Conductimet-



Automatic Chemical Injection System Flow Diagram

FIGURE 2—Here is a schematic flow diagram of the fully automatic treating system. Each well is treated in a time sequence.

ric type probes were inserted at the wellhead to assess the corrosivity of the casing gas, produced oil and power oil. In each evaluation, a negligible rate determination resulted, and the probability of serious corrosion damage in the immediate future was discounted.

However, it was not long before corrosion damage became evident. Eight months after the last completion, Well 3 was reworked to improve its producing potential. Several badly pitted collars were found in the production tubing string. Within the next month, two more wells failed as a result of holes in the tubing. Inspection of the tubing revealed several badly pitted joints. In each case only the outside of the tubing was attacked, indicating a severe pitting problem in the well annulus. Visual inspection methods were found to be inadequate in locating all of the damage since the majority of the pits were filled with scale and caked over with mud. Because of this difficulty, arrangements were made to electromagnetically inspect the tubing to locate damage. Tests proved that this method would locate corrosion pits under the mud and scale.

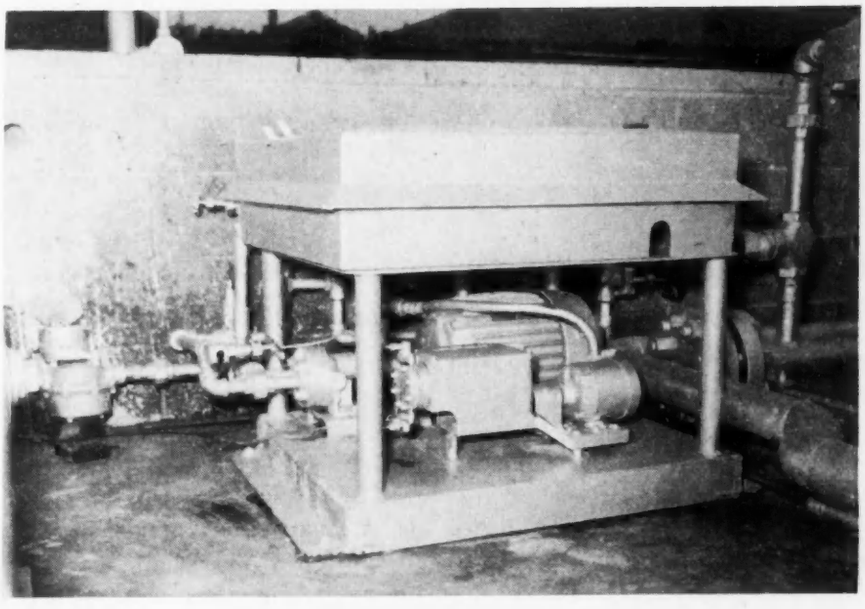


FIGURE 3—These remote controlled pumps introduce flush oil and chemical inhibitor into the casing annulus of the wells being treated. The small chemical pump shown in front of the flush oil gear pump is powered by a ¼-hp motor. The gear pump is powered by a 3-hp motor. The meter at left measures the flush oil used.

Since the corrosion damage was localized largely under mud deposits on the tubing exterior, it is believed that the pitting was induced by the presence of the mud around portions of the pipe. The scale in the pits was found to be corrosion products. This evidence indicated that the corrosion mechanism was deposit attack, and would not be detected by ordinary corrosion rate evaluation procedures. Corrosion products accumulating under the mud accelerated the pitting attack.

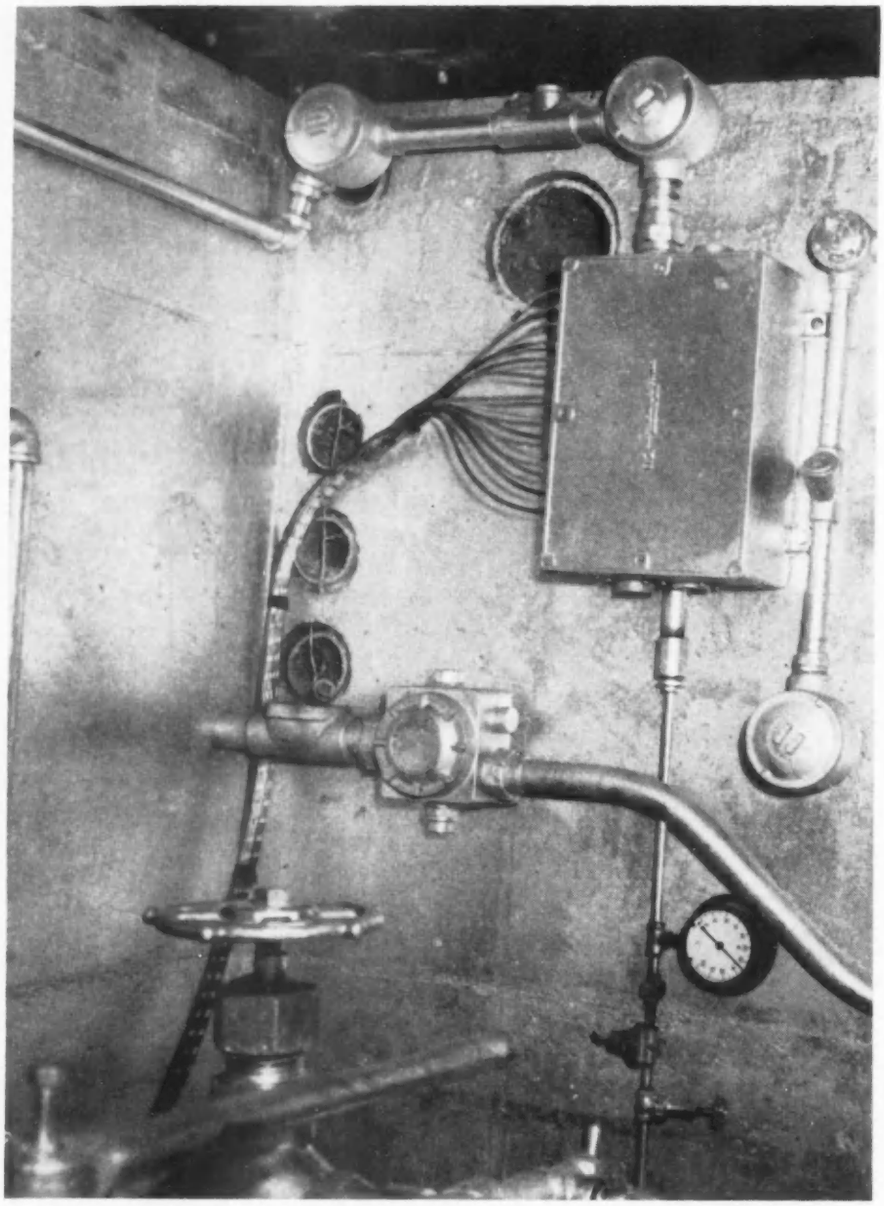


FIGURE 4—This air control valve box and distributing line control the pneumatic motor valves on the well heads of each well. The box contains solenoid valves arranged on an air manifold. Solenoids are operated by a central sequence timer.

A study was initiated to find the most effective method for minimizing further tubing damage in the six wells, and prevent similar damage in future development wells. Chemical treatment for corrosion control was started at this time.

Drilling and Completing Practice. A brief description of drilling and completing practices will be helpful in order to understand the problem. The six exploratory wells were directionally drilled with a clay-water mud on five-foot spacing in a common cellar (Figure 1). On completion, a triple tubing string for free-pump operation was installed, and the clay-water mud circulated from the hole with salt water, followed by crude oil. A study of this practice showed that in a high angle hole, considerable mud was by-passed during change over. The mud left in the hole is felt to be responsible for the severity of the corrosion problem.

The average drift of the directional drilling was 52 degrees with maximum in some holes of 74 degrees. Casing used was 8⅝-inch or 9⅝-inch tapered through the productive intervals to 7 inches with 5½-inch liners. The tubing bundle consisted of two 1¼-inch and one 2⅞-inch strings, clamped together. This bundle was run to the liner with a tail extension on the pump cavity extending into the liner. On completion, most wells exhibited casing pressures of 300-500 psi. After being pumped for several months these pressures were reduced to 100-300 psi.

Three-Phase Control Program. The corrosion control study resulted in a three-phase corrosion prevention program. The expense of pulling a three-string tubing bundle for repairs from corrosion damage called for a combination of the measures. The recommendations were:

- Continue the inhibitor program.
- Coat the tubing with a tough plastic.
- Revise completion techniques, consistent with drilling and production requirements, to permit effective removal of mud.

These measures were adopted during drilling of development wells. Of 31 wells completed, all receive inhibitor treatment; 23 contain external plastic coated tubing strings and, in 12 wells, plastic coated tubing was run with oil base drilling fluid in the hole.

To date, ten pulling jobs have occurred, eight of them for tubing failures from corrosion damage. All but two of these jobs involved the initial six exploratory wells. One well with plastic coated tubing has been pulled and the tubing was found to be in good condition. Where oil base mud was used prior to running tubing, no corrosion problems have been experienced.

Automatic Chemical Treatment System. The corrosion inhibitor treatment program was designed to coat the casing-tubing annulus with a film formed by the chemical and crude oil. An oil soluble, polar organic inhibitor was selected which wets the metal surfaces with crude oil. From 1 to 4 barrels of crude oil is used to flush this inhibitor into the annulus daily. It is believed this oil and inhibitor wicks itself over the surfaces of the metal in the well annulus. This should effect a reduction in the corrosion at-

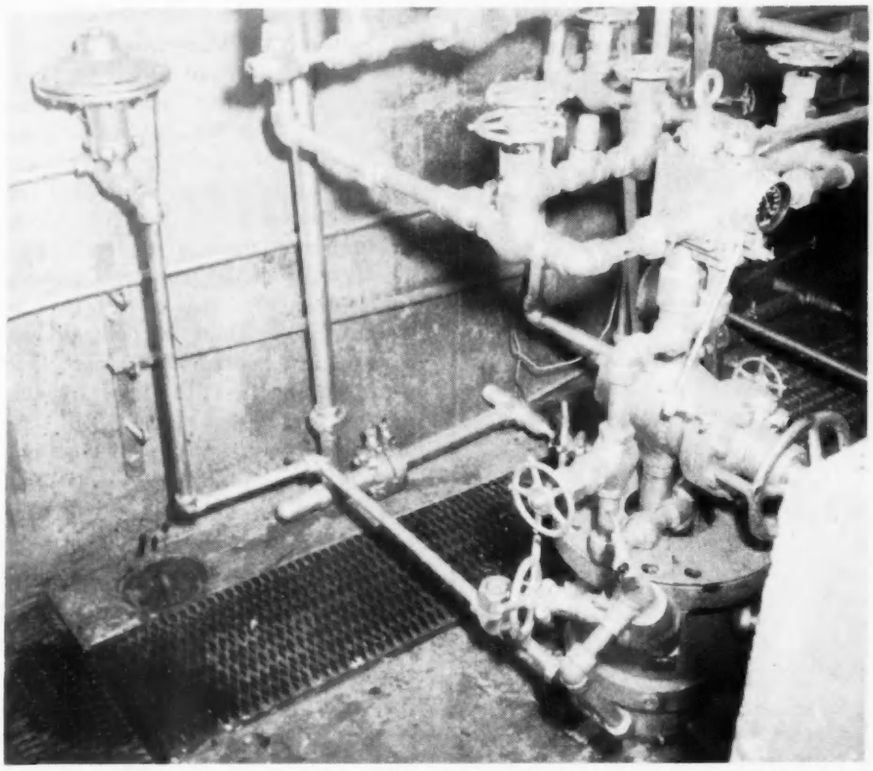


FIGURE 5—This photograph shows the 1-inch motor valve (upper left) which controls the flow of inhibitor-flush oil mixture into the casing annulus.

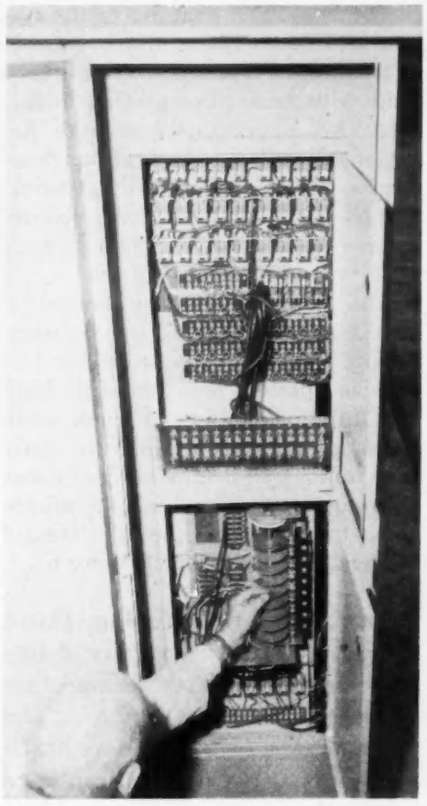


FIGURE 6—This program controller is composed of a sequence timer and a relay board. The upper cabinet contains relays which power the flush oil and chemical pumps in concert with the air solenoid valves. The lower cabinet shows the sequence timer that selectively operates the different relays. Cam wheels on the timer are supplied with adjustable pegs which operate micro-switches to the right of the cams. Adjustments in treatment are made by spacing pegs on the cam.

tack taking place on these surfaces.

Initially, the chemical and flush oil was introduced into the well annulus from a pump truck twice a week. Since wells were closely spaced, a fully automatic treating system was developed to treat each well on the lease in a time sequence. A schematic diagram of the system is shown in Figure 2. With automatic batching equipment, a more economical treatment with a better chance of controlling corrosion is gained. This system was installed and put into operation in

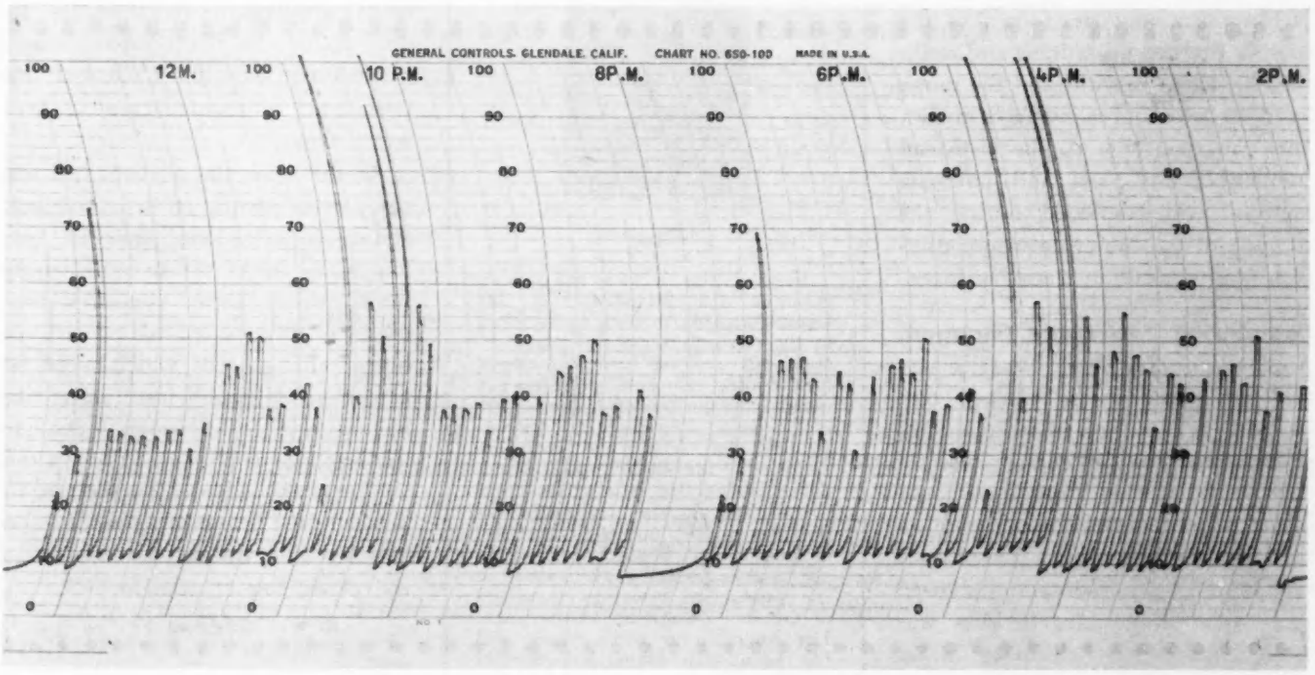


FIGURE 7—This flush oil manifold pressure chart shows casing pressures of each well treated during two treating cycles. Each pressure peak is a recording of an injection of flush oil containing chemical into a well.

September, 1958. Features of the system include a sequence timer capable of treating each one of the wells twice daily with flush oil containing inhibitor. This is accomplished with the use of a 2-gallon per minute oil flush pump and a micro-feed chemical pump coordinated with an electric-to-air operated valve system at each well head (Figures 3, 4, 5).

The flexibility of the system is gained in the design of the sequence timer. The timer may be adjusted to provide different amounts of flush oil containing inhibitor to each well. These adjustments are made by spacing tripping pegs on cam wheels that alternately cut in and out the micro-switches powering the air control solenoids for each well (Figure 6).

Plastic Coating for Tubing. Plastic coating of the outside surface of tubing was an untried measure for down-hole corrosion control. This approach was suggested in an article on low water cut corrosion as a means of corrosion prevention.[1] The corrosion processes described in the article seemed similar to the nature of the attack experienced at Redondo; both problems being that of deposit attack. After consulting a plastic formulator and an applicator, a catalysed epoxy phenolic coating was selected for use. The plastic was applied to the tubing in two 4-mil coats with 24 hours air drying after each application. After four days, the coating reached a hardness and resilience sufficient to withstand the rough handling procedures involved in running tubing strings. A plastic thread compound was used and patching material was employed during the running of the tubing to insure complete coverage of the exterior surfaces.

Completion Practices Changed. A change in completion practice was the last phase to be worked out. Initially, it was felt that some improvements in the change-over of clay water mud with crude oil could insure a more complete removal of the clay water mud. Laboratory studies and field observations showed this to be impossible. It then was recommended that the clay water mud be displaced with oil base type mud and the casing reamed while circulating before running tubing. The oil base mud then was to be displaced with crude oil to bring the well in. With some modifications this plan was adopted. Corrosion inhibitors also were added to the oil base mud to insure a good oil coating of the metal surfaces in the hole.

About the Authors

Hill

P. W. Hill, an engineer with Signal Oil & Gas Company, Los Angeles, has been active in engineering and research projects in the California petroleum industry. A longtime member of the Southern California Meter Association and the California Natural Gasoline Association, he has been active also in technical committee work for the National Association of Corrosion Engineers.

Kipps

H. J. Kipps, a technical service engineer with Signal Oil & Gas Company, Los Angeles, has worked in the research and development of chemicals and mechanical methods for treating oil field problems. A member of the National Association of Corrosion Engineers, he has instructed the science of corrosion control for the API at Long Beach City College. He is a graduate of the University of California at Berkeley in 1949 and the University of Colorado at Boulder in 1945, in chemical engineering. He worked in the production research laboratory of General Petroleum Corporation, Los Angeles, for seven years, and has been with Signal Oil & Gas Company for two years.

A review of the literature will provide sufficient evidence that the combination of hydrogen sulfide and carbon dioxide in production can cause serious corrosion attack to well equipment. The Redondo experience proved no exception although no trouble could be predicted from measurements made at the well head. The severity of the corrosion problem which developed was caused by clay water drilling mud left in the well annulus after completion. Since wells were equipped with triple tubing strings for closed power oil, free pump operation, repairs for corrosion damage to the tubing were tenfold more costly than with single string systems.

The attack was on the outside of the tubing in the well annulus, and was localized under drilling mud deposits. For this reason, corrosion control measures were directed primarily toward protecting the casing and the tubing surface in the annular space. Since only 6 of the 31 wells had been drilled before the problem was recognized, it was possible to make changes in well completion practices to avoid leaving clay water mud in future wells. Plastic coating the outside surfaces of the tubing was felt to be the most practical measure to minimize corrosion damage to the tubing. Of the wells completed with uncoated tubing and clay water mud, treatment with chemicals remained the only chance to effect some measure of corrosion control. Each well was placed on inhibitor treatment as it was drilled.

At this time the authors feel that the plastic coating of the tubing and change in completion practice have minimized the corrosion attack in the wells where these measures were used. Continued problems still require pulling wells which were not protected. Although insufficient time has elapsed to thoroughly evaluate the inhibitor treatment, it is felt that the program is providing benefit for not only the annulus corrosion problem but also throughout the rest of the producing equipment.

REFERENCE

[1] "The Theoretical Aspects of Corrosion in Low Water Producing Sweet Oil Wells—A Status Report of NACE Technical Unit Committee T-1C," prepared by Taft Group T-1C-4. Publication 58-4 January, 1958 issue of *Corrosion*, Page 33t.

FIGURE 1—This is a typical cross over crushing wire rope drum failure.

When to cut the drilling line

A well planned cut-off program will save contractors time and money

By C. M. Zerr, Chief Engineer
Union Wire Rope Corporation, Kansas City, Mo.

MANY DRILLING companies have established a rotary drilling line cut off procedure which, through trial and error, they have determined to be the best suited to their drilling conditions and staff work.

Consideration of a low service record on a line usually develops the idea of a need for a systematic evaluation and handling of the line. Companies with an established practice can almost immediately spot the cause of trouble. They then can take intelligent steps to remedy or change existing procedure.

There are many units of service established on which the work done is evaluated. In many cases, it is based on hours of operation, yards of material moved, tons lifted, or number of passes. In rotary drilling, the ton-mile generally has been accepted as the basis for measuring work done. The idea for measuring ton-miles dates back almost to the conception of rotary drilling. During the intervening years, such men as H. H. Anderson, K. N. Saatjian, V. V. Mason, F. H. Schnoor, A. B. Hockman, and many subcommittees have labored long and hard to develop a practical method of measuring the true value for the work done. Today, in the API "Recommended Practice on Application, Care, and Use of Wire Rope for Oil-Field Service" is found a complete, accurate and up-to-date method of evaluating rotary drilling lines.

The equations and methods of calculating the work as found in the API "Recommended Practice" do not lend themselves to practical use in the field. To help the driller keep an approximate running record, several wire rope manufacturers have developed slide rule calculators. These calculators, though not accurate, generally will meet field needs. In evaluating each line, the same calculator and procedure of determining the work done should be followed. Some of the calculators include the work done while drilling, while others require an extra operation to get the total figure.

Currently, an API subcommittee is working on the standardization of a calculator. To establish and maintain a procedure in the field for cutting off a rotary drilling line, the present slide rules are most satisfactory even with their acknowledged limitations.

Need for cutting off. The need for cutting off is immediately apparent to the most casual observer. Figures 1 and 2 are illustrations of two typical

FIGURE 2—An extreme wire line failure can be caused by a combination of speed, loading, winding and creeping.

FIGURE 3—This crack, the effect of martensite on the operational characteristics of the wire, will in time traverse the cross-section of the wire.

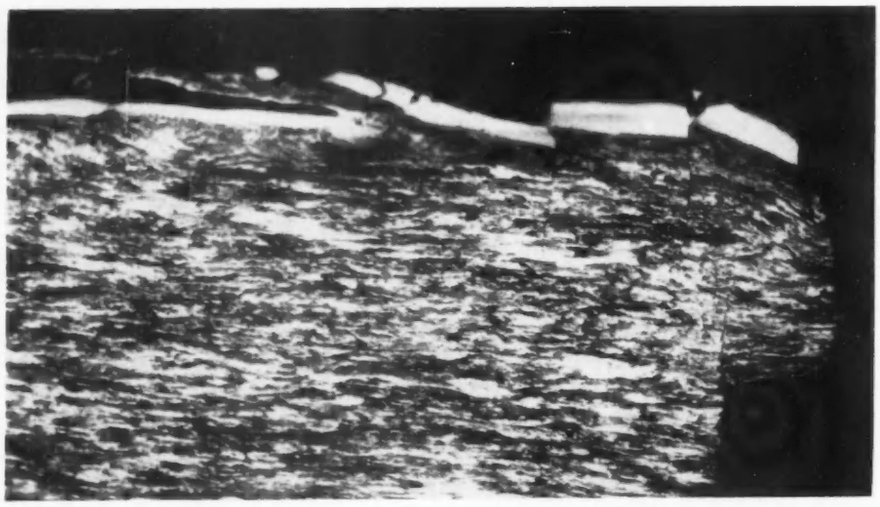


FIGURE 4—Here is a crack which has progressed across the cross-section and broken the wire.

conditions that, while extreme, are not unusual and exist in varying degrees of severity in every drilling line. Martensite, which is formed on the surface of the wire by a combination of speed, loading, winding, and creep, is one of the hidden sources of early wire failure.

Effect of martensite on the operational characteristics of wire can be observed readily from Figures 3 and 4. Figure 3 illustrates the start of a crack which in time, will traverse the cross-section of the wire. Figure 4 shows the broken wire. It also will be noted in this picture that other cracks are working their way through the wire. When to cut off is not so obvious and has been the subject of many discussions. Personal observations, opinions, experience, and responsibilities have been the influencing factors in determining when, how, and where the line is to be moved or cut.

Unfortunately, the nature of rotary drilling is such that the factors for cutting, which are dependent on human observations and feelings, are not accurate and the results are very unsatisfactory as well as costly. When broken wires appear on the drum or in the line, the cut off has been delayed too long. It is difficult to cut off what appears to be perfectly good wire rope. The rope generally shows just normal wear and possibly no broken wires. A tensile test on the rope generally shows a strength still above catalog. So the question is asked, "Why cut off good rope?"

Another human trait is to try and get just one more trip. Then, before

Attempt

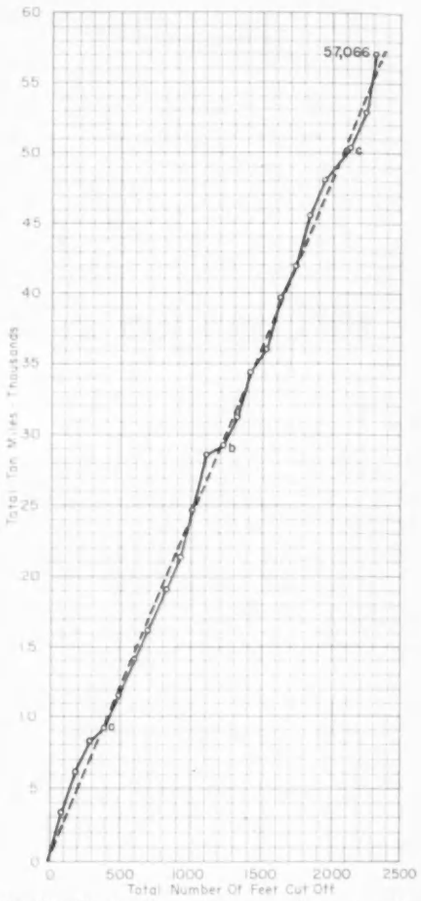


FIGURE 5—Here is a graph and table of the actual drilling line cut-off program of Well 101.

TABLE 1—Actual Data of Drilling Line Cut-Off Program of Rig 102

Rope Cut Off		Ton-Miles	
Feet	Accumulated	Ton-Miles	Accumulated
106	106	3,510	3,510
106	212	2,980	6,490
106	318	2,292	8,782
106	424	773	9,555
106	530	2,432	11,987
106	636	2,463	14,450
106	742	2,197	16,647
106	848	2,588	19,235
106	954	2,465	21,700
106	1,060	3,260	24,960
106	1,166	3,990	28,950
106	1,272	450	29,400
106	1,378	2,400	31,800
106	1,484	3,050	34,850
106	1,590	1,600	36,450
106	1,696	3,480	39,930
106	1,802	2,220	42,150
106	1,908	3,830	45,980
106	2,012	2,360	48,340
200	2,212	2,400	50,740
88	2,300	2,270	53,010
84	2,384	4,056	57,066

to get 'just one more trip' can be disastrous

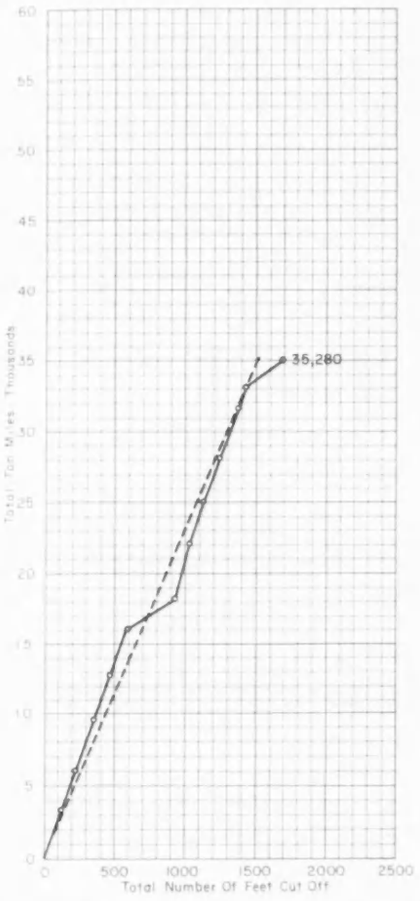


FIGURE 6—Here is a graph and table of the actual drilling line cut-off program of Well 102.

TABLE 2—These Are Accumulated Data of An Actual Drilling Line Cut-Off Program

Rope Cut Off		Ton-Miles	
Feet	Accumulated	Ton-Miles	Accumulated
106	106	3,426	3,426
106	212	2,958	6,384
106	318	3,562	9,946
106	424	3,170	13,116
106	530	2,996	16,112
390	920	2,188	18,300
90	1,010	3,750	22,050
106	1,126	3,122	25,172
106	1,232	2,983	28,155
*146	1,388	4,645	32,800
44	1,432	1,267	33,067
288	1,720	2,213	35,280

* Line removed from service because it was too short to string up 10 parts.

TABLE 3—A Savings in Drilling Line Results From a Well-Planned Drilling Line Cut-Off Program

Rope Cut Off		Ton-Miles	
Feet	Accumulated	Ton-Miles	Accumulated
90	90	3,410	3,410
90	180	2,495	5,905
90	270	2,952	8,857
90	360	2,595	11,452
90	450	3,542	14,994
380	830	131	15,125
90	920	2,103	17,228
110	1,030	2,610	19,838
110	1,140	3,035	22,873
110	1,250	2,234	25,107
110	1,360	2,543	27,650
110	1,470	2,302	29,952
110	1,580	2,943	32,895
90	1,670	2,096	34,991
70	1,740	1,809	36,800
110	1,850	2,490	39,291
150	2,000	3,546	42,837
110	2,110	2,263	45,100
90	2,200	2,900	48,000
100	2,300*	4,000	52,000

* Line replaced as too short to continue to use.

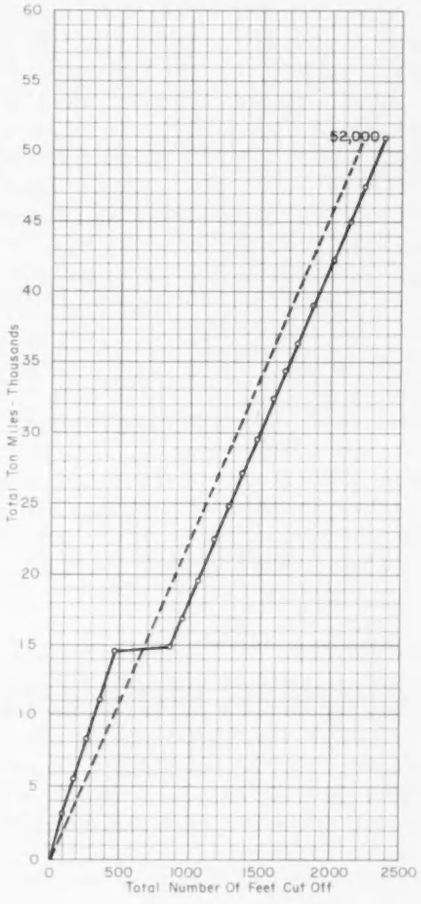


FIGURE 7—A well planned drilling line cut-off program will increase the total ton-miles. Dash line represents average of Figures 5 and 6 while solid line shows results of the planned program.

the line actually is cut or moved, conditions have developed whereby two or perhaps three trips have been made. And then broken wires show up through the fast line and it becomes necessary to cut off several hundred feet of costly rope.

Common causes. In considering and establishing a cut-off procedure, it always is necessary to include local and operational hazards which will adversely affect rope service. Some of the more common causes for substandard rope service or variations in the desired or expected ton-miles between cuts are as follows:

- Damage to rope when laying on ground between storage reel and tie down by kinking, running over with tractors or trucks, or pulling over, around or under pipe or steel shapes
- Improper tie-down equipment, method, or practice
- Improperly designed or maintained sheaves. This would include the condition of the bearings, shaft and groves
- Line whipping
- Running blocks into crown sheave
- Bad winding on the drum
- Excessive impact loads at pick up
- Overloading

Because these various conditions can be present or occur at anytime, regularly scheduled visual inspections of the rope are necessary. These inspections will be inadequate in determining the proper time to make a cut-off. Anytime a cut-off is indicated by excessive wear, crushing, broken wires or other mal conditions of the line which can be identified by a visual inspection, it will be found to be a costly cut.

Where a comprehensive study has been made on a specific rig, it has been found that there is a certain optimum ratio of work done to length of cut-off. This figure can be determined only by experience and is applicable only to that rig. Occasionally, identical rigs operating in the same field will have the same ratio for ton-miles

to length of rope cut-off. Drilling conditions in areas such as the Rocky Mountains, West Texas and Gulf Coast have an effect on the service life of the line. Therefore, no comparisons can be made between fields.

For a practical example, two identical rigs operating in the same field along with their daily reports were studied. From the historical data, it was found that rigs 101 and 102 were each averaging between 50,000 and 60,000 ton-miles on each line. Then on rig 101, two successive lines failed at less than 40,000 ton-miles. The third line, which was then in service, was breaking up and a 380-foot cut had just been made.

At the same time, rig 101 was experiencing the low ton-miles on the third rope, rig 102 found it necessary to make a similar long cut. With both rigs identical in construction and working in the same field, experiencing the same difficulty, it was apparent that a review be made of the drilling procedure.

Initial step. The first step in the study was to determine what practice had been followed on previous lines to establish the 50,000 plus ton-mile records. The data in Table 1, copied from the daily records of rig 102, are typical of the general practice carried out on both rigs.

The tabulated data show very little except that the feet cut off was the same with some variations showing up in the ton-miles at each cut. A picture of these tabulations makes an interesting study. The solid line, Figure 5, connects the actual experience data points. Note how—at cuts a, b, and c—a low ton-mile experience follows an above average ton-mile. In the study of the low service record which follows, this feature is the critical item in the procedure. A light dotted line was drawn through the data, representing a mean or average value. The slope of the dotted line is 23½ ton-miles per foot of rope cut off. Translated to the practice of this particular rig of cutting off 106; the driller should cut the rope between 2,400-2,450 ton-miles for optimum service.

The rope operating on rig 102, which was falling behind the expected service, had a service record as shown in Table 2, the data again being copied from the daily drilling records.

By the time 1,388 feet had been cut off (see asterisk), and it was obvious that something was wrong, the line was cut twice more and retired, because it was too short to string up 10 parts. At the same time, the cut off pattern was determined from a study of the plotted values, see Figure 6, an estimate was made as to the number of feet of rope cut off and ton-miles which would be accumulated at the next two points. The estimations were within 10 percent of the actual experience. Because of the early retirement of the line for the cause as noted, the recommendation of 2,400-2,450 ton-miles was not put into the practice.

Problem observed early. On rig 101, the problem of low ton-miles was observed early enough in the line's history to establish ton-mile values and actually demonstrate the value of using a cut off procedure based on field data to obtain the maximum work from a line.

A plot of the data in Table 3 (Figure 7), indicates the value of a well planned program. The first five cuts averaged 2,999 ton-miles, with the lowest value being greater than the ratio established in the preceding lines (see Figure 5). Following the long 380-foot cut, a close check was maintained at the rig on the accumulated ton-miles with cuts on the line as near to 2,500 ton-miles as practical. The results were gratifying.

On all the three graphs, the dotted line indicates the service that could be reasonably expected from the wire rope on either of these identical rigs. The difference between the ton-miles expected and the actual represents ton-miles lost by an over run. From Figure 6, the difference on this line is found to be approximately 4,800 ton-miles, or two cuts. Where on rig 101, 2,300 feet of line was cut off for a total of 52,000 ton-miles, the anticipated service was 54,000, or the loss of almost another cut.

Figure 6 also shows the typical frequency of a short service at each sixth cut. On rig 101 (Figure 7), the short service showed up again on the sixth cut. Other graphs plotted from previous lines fell into the same pattern when the rope was not moved at the rate of 23½ ton-miles per foot of rope cut off.

These data and graphs taken from actual daily reports and practice are typical of the more than average experience encountered in the field. The savings in cost of operation, as represented by increasing the service of a line, can be appreciable. The time required to make a picture of the mass of figures accumulated on each line is small, the savings from extending the service life of the rope will more than offset the time required to establish a procedure. The time required to plot each point when the moves or cuts are made takes little time.

In summary, it is found that wire rope used in rotary drilling is subjected to both external and internal forces which cause deterioration. Some conditions, which might be termed field abuse, can be controlled by taking these steps to be careful.

- Protect rope from the elements.
- Stop rough and careless handling while in storage.
- Install the rope on a properly designed skid or rack.
- String up properly.
- Use well designed hold down sheave.

Maximum service. Proper care in the actual working of the line by eliminating sudden jars, excessive snapping or whipping of the line, and keeping the sheaves, drums and braking equipment in good condition will pave the way for maximum service.

Operational hazards, such as fatigue from bending and loading, changes that take place in the structure of the wire itself, abrasion as a result of creep on the sheaves, grinding at the flange and crossover on the drums, are part of the attrition that accompanies the use of the rope.

The purpose of the cut-off is to get the most service out of the rope and, at the same time, work it through the reeving system before the rope breaks up in the working part of the line. Thus, when broken wires, from any cause, appear in the line, the cut-back to the fractures can be expensive in ton-miles that are lost.

Fortunately, educational programs are conducted by recognized authorities in which care of equipment and method of handling rope is carefully discussed and illustrated. In addition to these formal classes, literature is available on improvement of field practices. A study of the operational characteristics of each rig, followed by a planned cut-off procedure based on the study, will produce satisfying and profitable service records. —**The End**

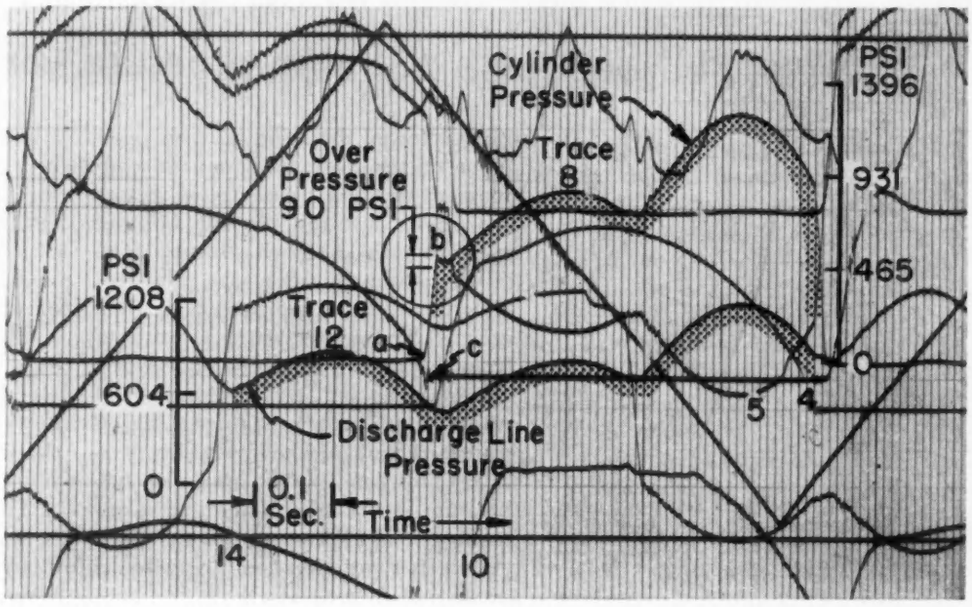


FIGURE 43—Notice the sharp rise in pressure from a to b while the pump cylinder remains closed.

PART 8: PRESSURES IN THE FLUID END

Know your mud pump—it can save you money

The pressure measurements within the mud pump must be thoroughly understood

By Samuel L. Collier, Research Engineer
Mission Manufacturing Company, Houston

THE PROBLEMS associated with fluid end operation, maintenance and evaluation of field tests can be corrected faster with an improved understanding of the pressure picture in the pump.

The previous articles have presented oscillograph records which showed traces of the pressure in the mud pump discharge line. Here we will examine the pressure measurements taken within the mud pump cylinder on each side of the piston.

The pressure pattern shown in Figure 43 is similar in both ends of the cylinder and both sides of the pump. The pressure produced on the stroke toward the head end of the pump is higher than the pressure produced on the stroke toward the power end of the frame. This is a result of the reduced volume pumped on the back stroke because of rod displacement.

The pressure pattern from point *a* to point *b* Figure 43 occurs while the pump cylinder is completely closed. During this period, although the suction valve has shut, the discharge valve is closed and mud is not allowed to flow in or out of the cylinder. The pressure rise during this period depends on:

- The compressibility of the mud
- The rigidity of the connections between the piston and crank under load
- The expansion of the fluid end under pressure
- Leakage around the moving parts

The suction valve was closed at point *c* so that any direct leakage of slippage was small.

The pressure within the cylinder must be increased to the line pressure before the discharge valve can be forced open. Because of the beveled lip on many valves, one might suspect that the pressure within the closed cylinder would rise above line pressure before the pressure load equals the pressure load above the valve disk. This extra pressure will be defined as over pressure. Generally, a valve is shaped with the top larger in diameter than the bottom so that the valve can open. Thus, a certain over pressure will be required for opening the valve.

The dimensions shown in Figure 44 are for a valve of the bevel seat type. In this case the upper area is 37

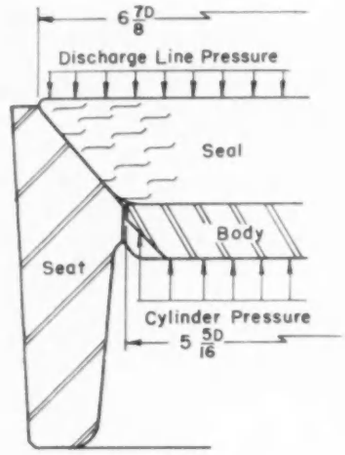


FIGURE 44—The forces are shown above acting on the valve disk just prior to the opening.

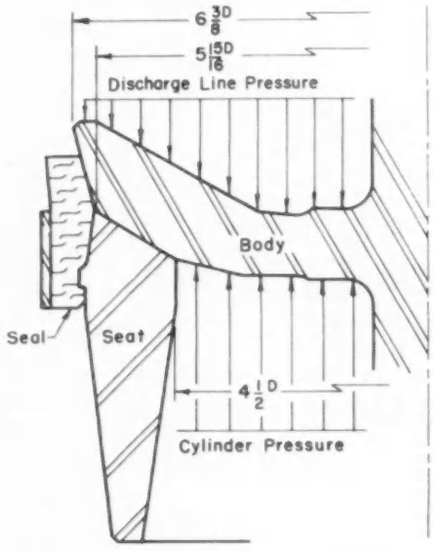


FIGURE 45—The valve has a metal to metal seat and is similar in this respect to the disk type.

square inches while the lower area is 22 square inches. For a force balance, the lower or cylinder pressure would have to exceed the upper or line pressure by 68 percent. Figure 43 is an oscillograph record of the actual pressure encountered during an operating test of a 5½-inch by 14-inch pump running at 60 spm and 1,000 psi line pressure. It shows that the maximum pressure that occurred in the cylinder before the valve opened was 540 psi (trace 8). The line pressure at the same instant was 460 psi (trace 12). Although the pressure during this stroke was as high as 1,238 psi, the valve opening took place at a much lower pressure. The over pressure was 80 psi. Similar data taken at various speeds from 20 spm to 70 spm and at other pressures up to the 3,000-psi

Pump pressure variations are almost

range showed the same general trend. None of the tests developed an over pressure as high as suspected before the valve opened. As the cylinder pressure rises the high pressure load on the discharge valve was balanced. The valve disk deformation is then relieved and the pressure is removed from the sealing member. The sealing material also acts as a hydraulic fluid rather than as a metal plate and transmits part of the hydraulic pressure. This tends to balance the line pressure in the area of the seat. Consequently, the pressure pattern suggested in Figure 44 does not actually occur.

A different valve that might approximate the disk type is shown in Figure 45. The area exposed to the line pressure exceeds the area exposed to cylinder pressure by 100 percent in this valve. This would indicate that the cylinder pressure should exceed line pressure by 100 percent to open the valve. However, the actual over pressure that occurred in operation is much less. The actual over pressure is shown for a typical test in Figure 46. This is a test of a 5½-inch by 14-inch pump at 60 spm and 1,200 psi line pressure. The cylinder pressure exceeded line pressure by 15 percent (85 psi) when the valve opened. Apparently the cylinder pressure occurs over the entire disk instead of just in the throat area. This will result in a low over pressure required for opening. Note that the over pressure is the same as that obtained with the beveled seat type valve for all practical purposes. *The over pressure is so small that it has no detrimental effect on the life of the valve or pump.*

The valve again closes at point *c* Figure 46. (Valve lift is trace 4.) The pressure falls rapidly as the piston moves to the end of the stroke while the stresses in the cylinder and suction pot falls to zero.

The stresses within the fluid end between the suction valve and the discharge valve are cyclic stresses. They follow the pressure and are loaded from a low to a high stress on each stroke. This load and unload cycle also takes place on the discharge valve as it seats and unseats. However, it occurs during the suction stroke when the pressure over the valve is high and cylinder pressure is suction pressure.

The life of this part of the fluid end between the suction and discharge valves depends on the corrosions fatigue strength of the material. As discussed in Part 7 (WORLD OIL, February 1, 1959, Page 75) the corrosion fatigue strength is less than the static load strength.

Although it is difficult to generalize, this may be the reason why more cracks will occur in this part of the fluid end rather than in the area above the discharge valve. While in

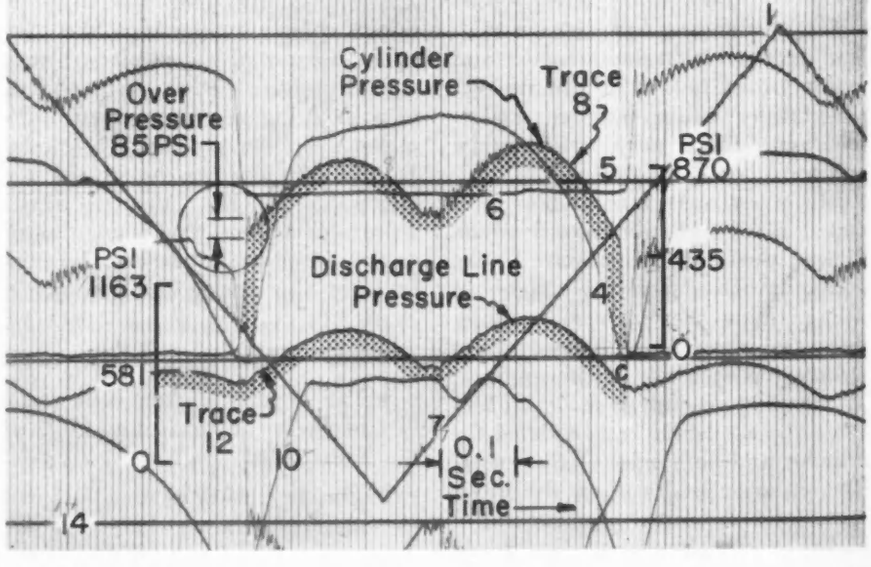


FIGURE 46—Here is shown an oscillograph record of the pressure for the metal to metal seat valve.

eliminated when a discharge pulsation dampener is used . . .

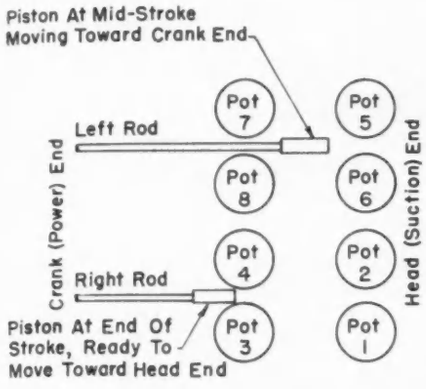


FIGURE 47—Here is a diagram of the piston and valve positions in a typical mud pump.

operation, the pressure above the discharge valve is always exposed to line pressure. Although this creates high stresses, it is a relatively steady one. The effect of the high steady stress is less than one that would be of a cyclic nature.

A review of the pressure pattern in the entire fluid end discloses that some of the pots (Figure 47) are always exposed to a higher or lower pressure than others.

In Figure 48, when the pump is discharging through pot 6, the left head end and the suction valve pot 5 is exposed to the pressure from points *a* to *b* to *c* (90° to 270°). Compare this to the pressure from points *c, d* to *e*. Pressure *c, d, e* is the line pressure to which the left crank and suction valve pot 7 is exposed later in the stroke. The average of these two peaks from points *a* to *b* to *c* is 1,480 psi while the average for the two peaks between *c, d, e,* is 1,090 psi. This is 390 psi or 27 percent lower.

The discharge valve in pot 6 is open from *a* to *b* to *c* and is floating in the high pressure fluid but does not carry the pressure load. The discharge valve in pot 8 is closed throughout this period and thus is the most highly loaded valve. In the same manner the discharge valve chamber pot 6 is closed when the low pressure *c, d, e* occurs. Consequently, the discharge valve in pot 6 has the lowest pressure load of any discharge valve.

The average power pump crank rotates clockwise with the right rod leading the left 90° (Figure 47). With this arrangement, pot 6 and its valve will always have the lowest pressure load while pot 8 will always have the highest pressure load. Suction pot 5 will always be exposed to the same high pressure as discharge pot 8. However, suction pot 7 and its valve will always be exposed to the lowest discharge pressure peak.

The left side of the pump is exposed to a much wider range of pressure fluctuation and pressure peaks than the right side. The conditions on the right side are more average for all four pots. All other things being equal, the left side is an average for all four pots. All other things being equal, the left side of an average pump can therefore be expected to give a wider variation in equipment life.

Fortunately the variation is practically eliminated when an adequate discharge pulsation dampener is used. The economy of obtaining closer to average life at all points in the pump is thus another justification for installing a good dampening device on the discharge line.

TO BE CONTINUED

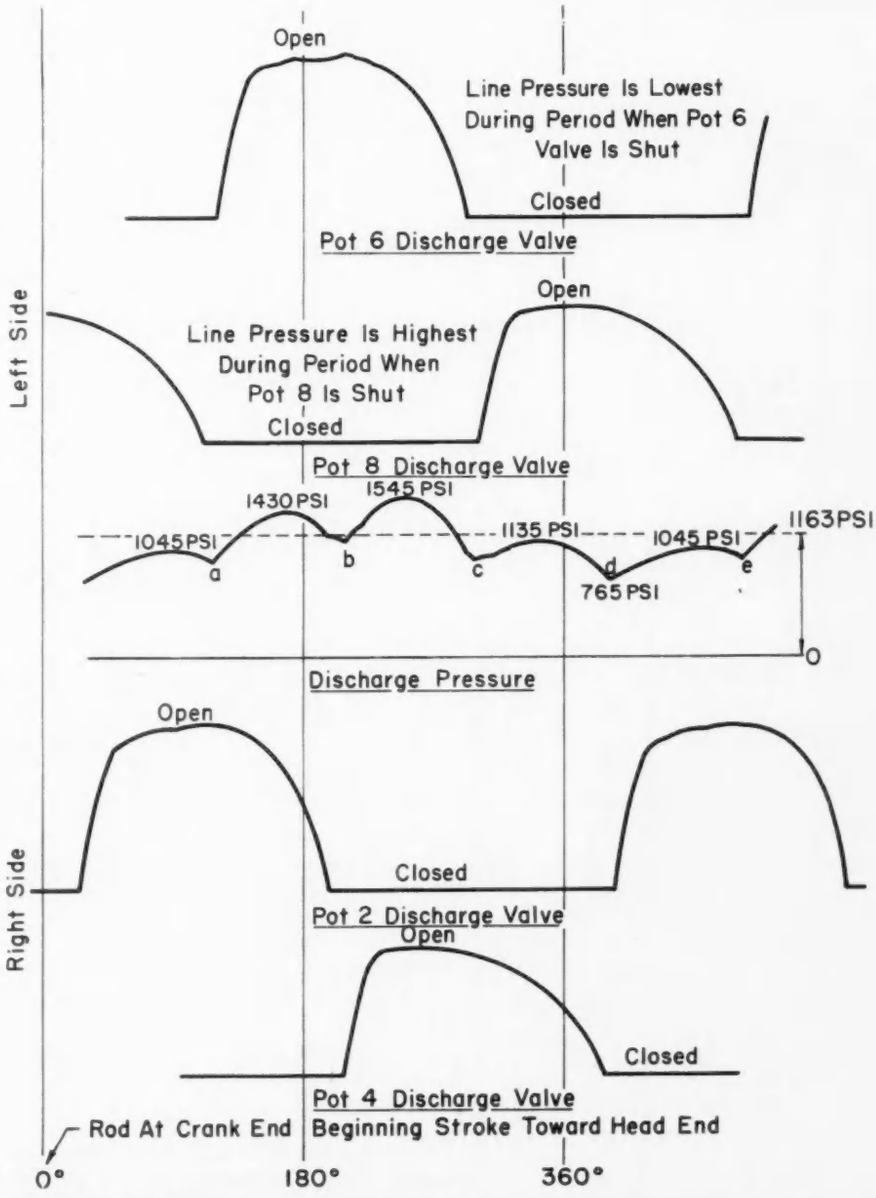


FIGURE 48—Here is shown the pressure distribution in the fluid end of a mud pump and also the respective discharge valve that is open.

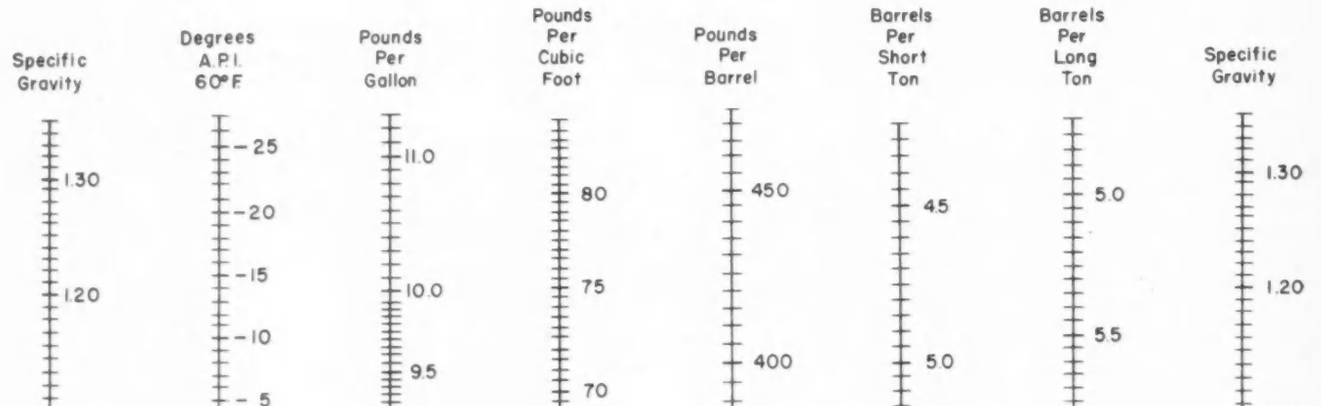
Here's a helpful . . .

Liquid gravity and conversion chart

This easy-to-use chart will prove useful in the doghouse, knowledge box and brief case. Gravity conversions are quickly obtained with only a straight edge

By Marvin H. Green
Philadelphia, Penn.

This line chart provides an easy method for converting units of liquid gravity and density. Draw a horizontal line perpendicular to the scale line through a known value and read the equivalent value on any other scale.



LIQUID GRAVITY AND DENSITY

PART 2

Water can be controlled in air and gas drilling

Sealing materials used in the laboratories and field operations are proving successful

By Wayne F. Hower, Charles McLaughlin, Joe Ramos, and John Land
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Duncan, Okla.

WHAT TYPE of material should be used to seal off encroachment formation water? Two basic materials were proven quite successful. One true solution, a polymeric water gel (PWG) is a low viscosity material that will set to form a stiff gel. PWG has a viscosity of about three centipoises and this viscosity is maintained until it starts to set. Figure 3 is a representative time-viscosity curve for the PWG. Also shown is a typical curve usually found for most resins. Such a viscosity-time relationship is of great value as the solution remains in an ideal penetrating and pumping condition for about 95 percent of its fluid life. A representative sample of set PWG is shown in Figure 4. Once PWG starts to set, the reaction is very rapid and a maximum stiffness is obtained in a relatively short time after its viscosity starts to rise. As it is with almost all materials that polymerize, the reaction rate of PWG depends on the temperatures to which it is exposed. Therefore, for minimum waiting time and savings in rig time, an accurate formation temperature is required so that the proper formula can be mixed for each particular treatment. For most applications, a 4 to 6 hour waiting time would be maximum for the PWG to set. Where a reliable formation temperature is available, a set can be obtained in as little as two hours.

Stiff gels are applicable. Stiff gels have shown remarkable plugging properties when placed in permeable matrices. Cores having a permeability as high as 3,000 millidarcys and only one inch long have withstood 2,000 psi hydraulic pressure. Failures at higher pressures were due to fracturing of the core or leaks in the core mounting system. A column three inches long and two inches in diameter made of 40 to 60 mesh Ottawa sand was saturated with PWG. A one inch diameter ring was placed at the bottom of the chamber and, after the PWG had set, it required a steady pressure of 2,500 psi to extrude the consolidated sand as a one inch cylinder.

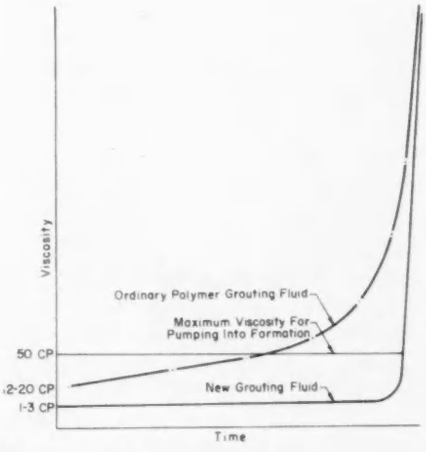

FIGURE 3—Comparative time—Viscosity curves for conventional polymeric materials and the new grouting fluid (PWG). The sustained low viscosity of PWG is highly desirable when grouting low permeability formations.

The importance of using a packer had been stressed in the placement of these materials. For this reason, it was deemed necessary to determine whether such a stiff gel type material as this would stick a retrievable packer in the hole. Therefore, as an integral part of one treatment, enough unset PWG was pumped on top of the packer to fill 30 feet of annular space. The packer was set, the formation treated under the packer and, after the PWG had set, the packer was unset and pulled from the hole with very little difficulty. Since that time, a packer leaked PWG during an air drilled well field application and, again, the packer was retrieved without difficulty. In other instances, set PWG has been pumped out of drill pipe a stand at a time at nominal pressure differentials.

Further research has shown that the unset PWG can become diluted with as much as 25 percent excess water and still provide a set product of practically the same strength. A slight loss in strength was recorded at 100 percent dilution. A fair set was obtained at 200 percent dilution and a very soft set was noted at 400 percent dilution. The fact that PWG will still give very good sets after being moderately diluted plus the doubtful possibility of sticking a packer in the hole makes the use of the solution very attractive.

Four separate zones were treated with PWG in the test wells and all were successful in completely shutting off water production. Here, zones varying in thickness between 10 feet to 16 feet were treated with 210 gallons PWG to shut off water production of 17.5 to 31.5 gallons per minute. In one instance, the well was deepened several times, two cement squeeze jobs were performed to control heaving red bed and deeper zones were treated with other solutions. All treated zones were side wall cored and, after this severe treatment, water production still remained at zero.

Field applications of stiff gel material. Successful field applications have been made in air drilled wells in west Texas and north Texas. One 30-foot zone making 12 barrels of water an hour was completely shut off with 600 gallons of PWG. Another zone of 20 feet making 9 barrels an hour was reduced to three barrels an hour. A second treatment completely stopped the flow of water. The two treatments on this zone were made in 80 feet of open hole with no packer set in the formation. As this hole was deepened, additional water was found in three zones covering 90 feet of formation at 200 feet below the casing. The bradenhead squeeze treatments in this amount of open hole were not too satisfactory. It required five applications to reduce the flow of water from 50 barrels an hour to essentially zero. It is strongly felt that this last horizon could have been sealed with two applications if a packer had been used. However, valuable information was gained from these bradenhead squeezes. It was found that it took an unusually long time to dry up the well or obtain a steady water flow rate after a squeeze. It is believed that unproductive horizons will accept a certain amount of fluid under pressure. Since there is no formation pressure available to rapidly discharge this fluid after the hydrostatic pressure in the hole has been removed, the fluid will gradually bleed back into the hole over a relatively long period of time. Thus, it is difficult to quickly determine the true condition of the treated water bearing formation. Another source of water is condensed water from air compressors. Water production in one instance was reduced one quart a minute when the sun came up and warmed the air. Water of this type would probably not be noticed in a dry hole but where the entire hole has been in contact with water for sometime, essentially all of the water condensed in the air stream returns to the surface. This information strengthens the argument for isolating the water zone with the proper packer assembly.

The well in north Texas was treated with 300 gallons PWG to shut off a small or weeping flow of water. Recommendations, at this time, are to use 10 to 20 gallons of PWG for each foot of formation being treated. It is hoped that additional field work will better establish the requirements for successful applications.

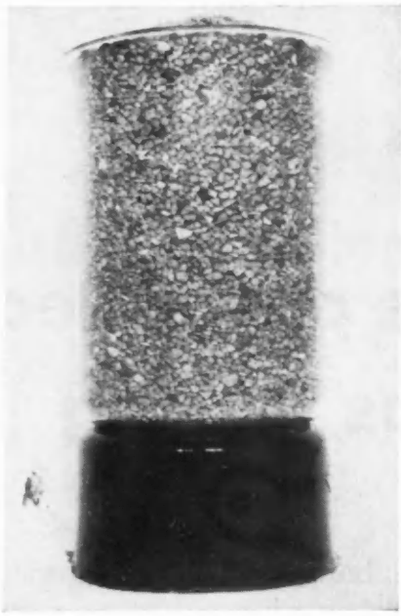

FIGURE 4—The stiffness of the set of the polymeric water gel is illustrated as it supports several times its weight of gravel.

Difficulties have been encountered. One application was not successful in that the quoted formation temperature was about 25 degrees higher than actual well conditions and not enough time was allowed for the PWG to set. Another well had a lost circulation horizon very close to the water producing zone. It was much easier for the low viscosity PWG to enter the lost circulation zone in preference to the water producing formation.

The low viscosity of PWG is a definite advantage in obtaining positive penetration in relatively tight formations. However, when conditions exist where the hydrostatic head will overbalance formation pressures and continue to displace fluid after pumping has stopped, it has been found to be a distinct advantage to use shut-off plugs to control the final displacement of PWG. Formulas have been developed to cover the range of 40° F. to 200° F. for the polymeric water gel.

Resin slurry described. The other basic material developed by the joint laboratory-test well research program is a new type of resin. This research proved that the resin can be used in either of two forms. They are: (a) As a relatively low viscosity resin, (b) Combined with certain inert solids to give a bulking effect and to control the fluid lost from the slurry to the formation. Figure 5 is an example of the set resin slurry when it is squeezed against a water saturated unconsolidated sand. Resin forced from the dark slurry has entered the white sand to consolidate the sand and plug its flow channels. A very tight bond is developed between the resin slurry and the formation as evidenced by the broken example shown in the illustration. The sample would not break in the slurry or at the interface but in the sand consolidated portion of the sample.

The strength of the set resin slurry and the resin saturated formation will vary and will depend on the well temperature, the differential squeeze pressure and formation characteristics. For example, the resin slurry, when squeezed into an 80 to 100 mesh loose sand at a 20 psi pressure differential has given, after 4 hours at 120° F., a compressive strength of 2,010 psi for the slurry and 1,050 psi for the consolidated sand. Similar data has been obtained for the 80° F. formula while, after 4 hours at 200° F., a compressive strength of 3,958 psi was obtained for the slurry and 2,509 psi for the consolidated sand. Where the water bearing formation is competent, it would be possible for the compressive strength of the resin saturated formation to be greater than the set slurry.

The resin, which was developed before the resin slurry, has been used successfully to shut off water in an air drilled well. It has also been used successfully to shut off conventional water flows in the research test wells. However, because of economic reasons and the fluid loss control properties inherent in the resin slurry, it is believed that the bulk of future applications with the resin will be as a part of the resin slurry and not by itself.

The slurry normally weighs 16.5 to 17.5 pounds per gallon while the resin weighs 10.8 pounds per gallon. Again, a fairly accurate formation temperature is required so that the proper amount of catalyst can be added to the resin. The catalyst-resin ratio is adjusted to provide sufficient pumping time for the placement of the slurry. Water also acts as a catalyst and further accelerates the set of the resin once the slurry is squeezed against a water bearing formation. Under most conditions, the slurry will be set in two to four hours in the well but, a sample saved on the surface

and held at the same temperature will still be pumpable. This is a very desirable feature as a long pumping time is available for the slurry placement but only a relatively short time is required for the slurry to set as it is further catalyzed by water as it is squeezed in place. The fact that water acts as a catalyst for the resin also helps to control the slurries fluid loss. Visual examination through a microscope of a thin water wet sand during the resin squeeze has revealed that the resin and water mix in the flow channels. It was also shown that a marked increase in viscosity of the resin was soon obtained which decreased its ability to further penetrate the sand.

The fluid loss of the slurry cannot be controlled to an exact degree but two formulas are available. The regular formula is modified with another solid to reduce the amount of resin that leaves the slurry. The nature of the formation and the differential pressure applied across the slurry are the governing factors on how far the resin will penetrate. Resin penetration of 1 to 6 inches has been noted in laboratory tests.

Resin slurry applied to fractured zone. The resin slurry seems to be particularly adaptable where fractured formations exist. A mud drilled well in West Texas would lose circulation at a certain mud weight and produce a corrosive sulphur water at a lighter mud weight. A drillable retainer, with a 95-foot drillable tail pipe, was set on top of 105 feet of formation in the 8¾-inch hole. The volume of hole to be treated was calculated with a 25 percent excess of resin slurry being prepared. This job required the use of 396 gallons of resin slurry to be placed in the 7,700-foot wall. A relatively low pressure squeeze was placed against the fractured dolomite formation and, by the time a round trip could be made to place a bit on the drill pipe, about four hours had elapsed. The retainer and set resin slurry were drilled out and the 4,250 psi water bearing formation was found to be sealed. Other applications of this type have been successfully performed.

A retrievable packer has been used in placing the resin slurry and extra care was observed in making certain that the slurry was completely displaced from the tool. Fortunately, the packer did not leak and permit any of the slurry to circulate on top of the rubber element. It is the thinking of many people that it is safer to use a drillable retainer with the resin slurry and plan to drill it out than take a chance of sticking a retrievable packer.

It would be very difficult at this time to exactly define where one would prefer the use of PWG over the resin slurry. PWG seems to be more adaptable in low permeability formations and where a deeper penetration of sealing material is desired. Its stiff set makes it easy to drill out of the hole. Also of an advantage is the safety factor in not having much of a chance in sticking the packer and plugging the drill pipe. The resin slurry will set much harder and will control higher pressure formations. It also is more adaptable for fractured zones and it can be used at temperatures from 40° F. to 240° F. or even higher. PWG costs less than the resin slurry which could enter into the selection of the material to use. However, less resin slurry is generally required for an application which could balance out the cost of the materials.

The schematic diagrams shown in Figure 6 are representative of three basic plugging systems. Figure 6A illustrates the fracture sealing properties of conventional cement slurries which leaves practically all of the formation free to produce water. Figure 6B illustrates the permeability sealing (light shaded areas) and fracture plugging properties of the resin slurry. Figure 6C illustrates the complete saturation and plugging of a variable permeability formation with the polymeric water gel.

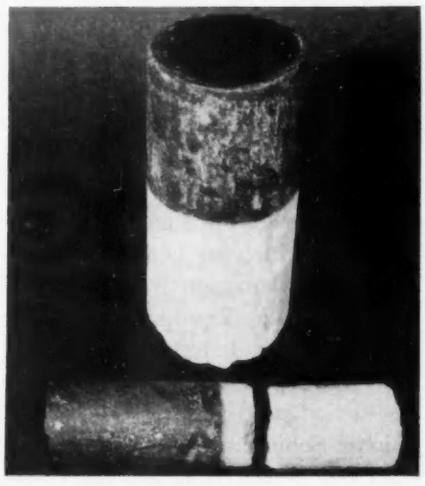

FIGURE 5—The resin slurry, as represented by the dark portion, was squeezed into unconsolidated 80 to 100 mesh white sand. Resin leaving the slurry consolidated and plugged the sand. The small broken piece illustrates the strong bond that is developed between the sand and resin slurry in that the break did not occur at the interface.

Materials have other applications. The field use of both materials has not been limited to the control of water in air drilling. PWG has been very successfully applied to an oil producing well where it was desired to obtain penetration and plugging of the formation to alleviate the damaging effects of water coning. Such an effect had not been obtained by the use of conventional slurries where their blocking action depended on solid type plugs in perforations and induced or natural fractures. In the particular PWG application mentioned above, the displacement of the plugging fluid was controlled with a plug so that only the volume of the hole below the packer was displaced with water. As a result, the hole did not need to be cleaned out or reperforated before oil production was regained. However, well conditions exist in other areas where a more exact placement will be necessary. Neither PWG nor the set resin slurry are soluble in well fluids or any conventional solvent. Therefore, a thorough study of well conditions is essential in planning the placement of the materials. Relatively short half life radioactive tracers have been used to spot similar solutions and their use should be applicable for these new materials.

PWG has not, as yet, been placed with the dump bailer. Its normal weight of 8.5 pounds per gallon does not point toward an easy placement but the solution can be weighted to 10 pounds per gallon without too much trouble. The heavy weight of the resin slurry is very favorable for dump bailer applications and the slurry has been so used very successfully in several oil producing wells. The hard set, good bond to the formation and relatively short set time make it very attractive for this use. Only recently, the resin slurry performed satisfactorily in a Granite Wash formation where other materials had failed.

Water-flooding. Thief zones in water injection wells are one of the major problems in this type of secondary recovery. The plugging of the formation to a depth with the low viscosity PWG is a very attractive

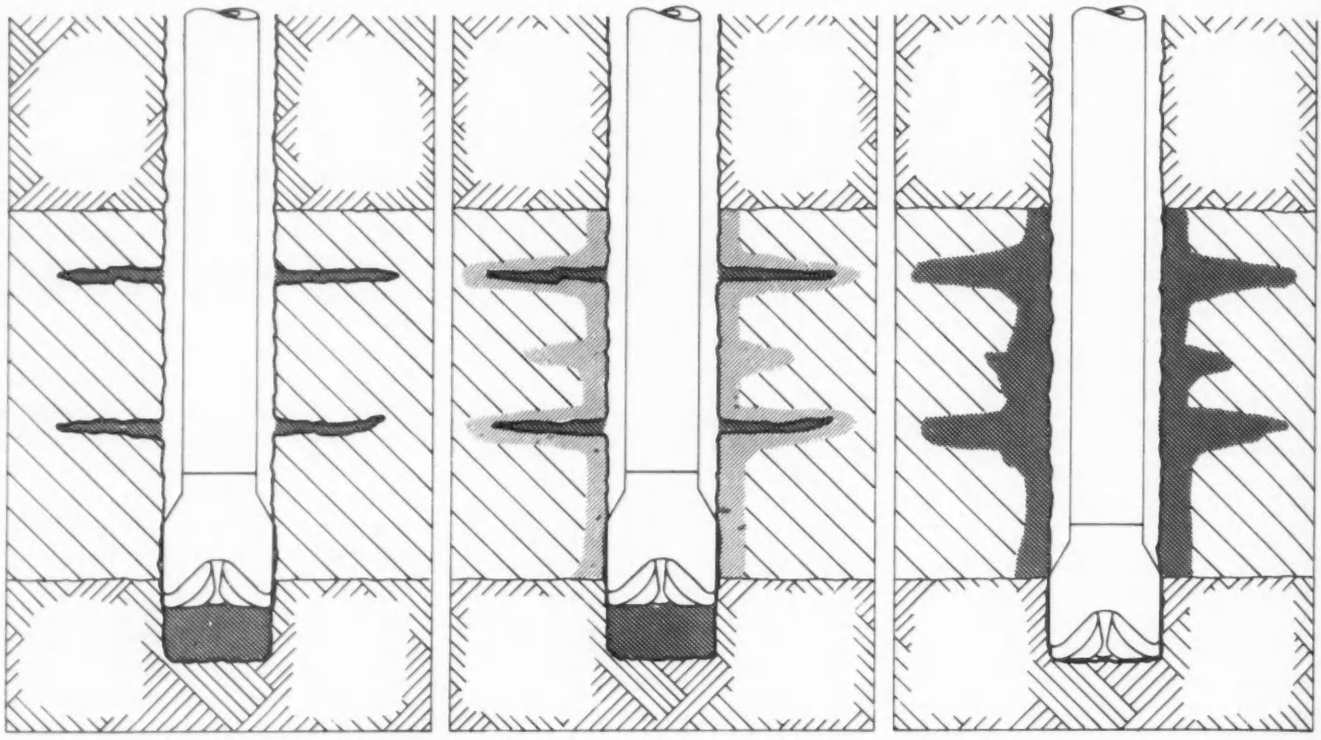

FIGURE 6a—Conventional cement slurries plug fractures but leave the remainder of the formation free to produce water.

FIGURE 6b—The resin slurry plugs the fractures and seals the true permeability of the water-bearing zone as shown by the lightly shaded areas.

FIGURE 6c—The low viscosity polymeric water gel has entered and sealed a formation that has a varying permeability profile.

FIGURE 6—Schematic illustrations of three basic squeeze materials.

procedure. A successful placement has been made in an injection well with the PWG where it was suspected that a fracture provided a direct flow channel to a producing well. Placement with radioactive tracers may be of an advantage under some conditions. Where a harder set material is needed to seal large fractures or for plugback work, the resin slurry is more adaptable and has been used for this purpose.

Fluid grouting applications show good promise. There has been a constant demand for materials to grout and stabilize soils in shallow to relatively deep sub-surface conditions. Consolidation and plugging around mine shafts, dams, tunnels, and subsurface building construction are examples of areas where this type of work is applicable. Cement slurries have been used to an advantage in some instances but the inability of cement to penetrate the true permeability of the soil affects its efficiency. Several true fluids have been successfully applied in certain areas. With some of these, the set of the material is dependent on one solution contacting another solution in the interstices of the formation. Such a system is workable under some conditions but not as efficient as a one phase solution where the entire liquid system will react to form a set product. The polymeric water gel has properties that are good in shallow fluid grouting operations, and its use has been very successful under a variety of conditions. As stated previously, the original PWG solution can become diluted with formation water and still give a good set. This high yield of set material is very desirable. In addition, the set time of the solution can be varied and controlled to fit local conditions. Solutions having a set time of a very few minutes to more than an hour can be formulated and a rapid evaluation of the results can be obtained due to the fast accumulation of strength of the set product. The resin or resin slurry would be adaptable for highly porous formations and where a product of high strength is desired.

Conclusion. The resin slurry and polymeric water gel are relatively new materials. Both have unique and desirable properties that make them attractive for both oil field and fluid grouting problems. The polymeric water gel has been successfully applied for the control of water in air drilled wells, oil producing wells and in shallow and deep grouting problems. The resin slurry has proved of value both in drilling wells and producing wells. Both materials are field proven but research is continuing in an effort to improve both products and placement techniques. In addition, the air drilled test wells are being used to evaluate new ideas in an effort to make available the best possible materials and treating techniques for the control of water under all environments. This includes a new concept where gaseous chemicals are injected into water bearing zones to form precipitates *in situ*. —**The End.**

Raton basin potential excellent in Colorado

Definable folding, possible stratigraphic trap development and suitable porosity increase commercial possibilities

By Joseph R. Clair
Geological Consultant, Denver

NOT ONLY are structures suitable for entrapment of oil and gas present in the Colorado portion of the Raton Basin but also reservoir rocks which are commercially productive in other areas are similarly developed in this area. Consequently, the area is one of tremendous potential and worthy of consideration.

For many years, the Colorado portion of the basin has provided a great challenge to prospectors. Semi-commercial shallow gas at Garcia, the helium gas field at Model Dome, shows of oil in wells drilled, and surface oil seeps have provided encouragement. However, the northeast quadrant of the Basin has been virtually neglected. This article discusses that area.

Many shallow wells have been drilled throughout the Colorado portion of the Raton Basin. However, little or no data are available on these tests. Accompanying maps show only those wells which have penetrated the Pennsylvanian, or older, beds.

The earliest reported production was on the Garcia anticline. In 1892, wells were drilled and gas encountered was used for light and heat by surrounding ranches. No commercial use of the gas was made until about 1934 or 1935 when a small gasoline absorption plant was built. Annual production was negligible and the plant was dismantled in 1943 or 1944.

Evidence shows that 13 producing gas wells were drilled. No information is available as to original pressures or volumes, though one well reportedly had an open flow of 1½ MMcf. Two wells still producing in 1956 were supplying ranch fuel and still were adequate for this purpose. Production is related to fracturing in the Apishapa, Timpas-Codell and Greenhorn formations. No production was found in the Dakota, though two of the higher wells on structure penetrated this formation.

The only show of Pennsylvanian oil in the Raton Basin was found on the flank of the structure. The Sullivan & Taylor #1 Dutto-Marchisio, NW/NW/NE of Section 27-T33S-R62W encountered shows from 3180 to 3475 feet in the upper part of the Sangre de Cristo formation. Three drill stem tests at various intervals recovered up to 75 feet of heavily oil cut mud and one foot of free oil. Flowing pressures were low, but shut-in pressures were fairly high (1,000 psi). Oil recovered was a heavy black crude (26.6 gravity). Attempts to complete the well as a commercial producer were unsuccessful partially because of mechanical difficulties and partially because completion was attempted some seven months after the drilling operations had ceased.

In 1926, the discovery well (Foley and Goldsworth Government 1, NE/NW of Section 1-T30S-R60W) on the Model anticline encountered the top of a gas bearing sand at 900 feet and water 140 feet below the top of the sand. This well reached a total depth of 2,010 feet. The producing sand is correlated with the Glorietta (Lyons) sandstones of Permian (Leonardian) age. The drillers' log records the Glorietta as being 270 feet thick, below which

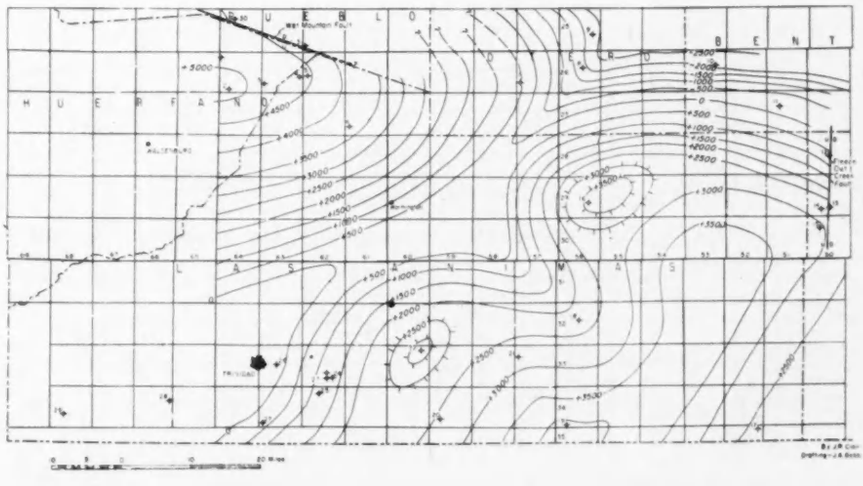

FIGURE 1—This subsurface structure map of the Colorado portion of the Raton basin was constructed with the top of the Pre-Cambrian as a datum. Contour interval is 500 feet.

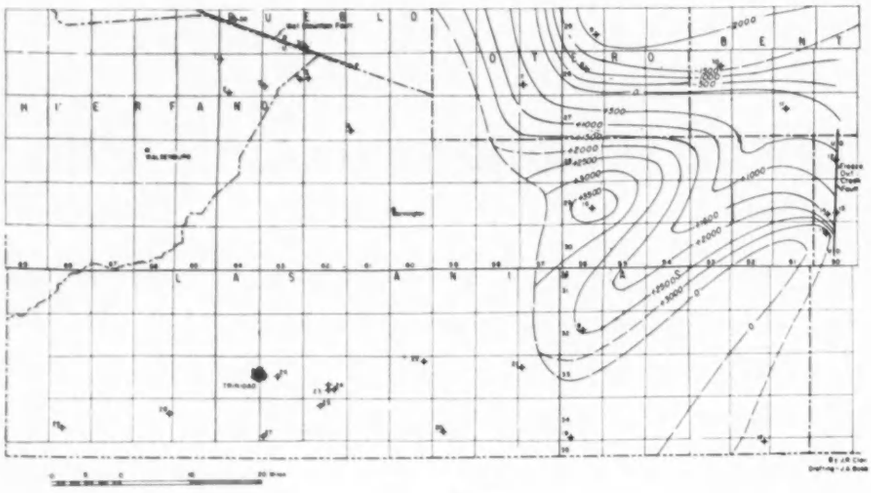

FIGURE 2—The top of Arbuckle rocks was used as a datum in this structural map of the area. Contour interval was 500 feet.

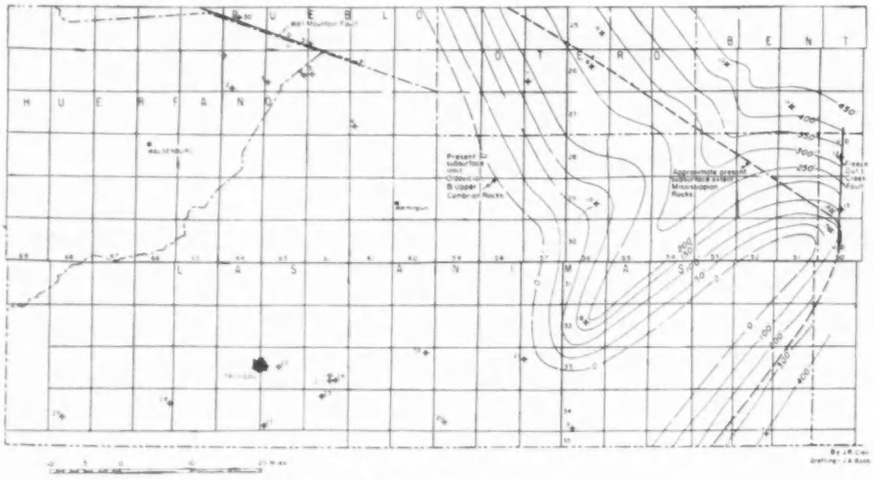

FIGURE 3—Here is an isopachous map of the basin with the thickness of Ordovician and Cambrian rocks used as a datum. Contour interval is 50 to 100 feet. The dashed line shows the approximate subsurface extent of Mississippian rocks.

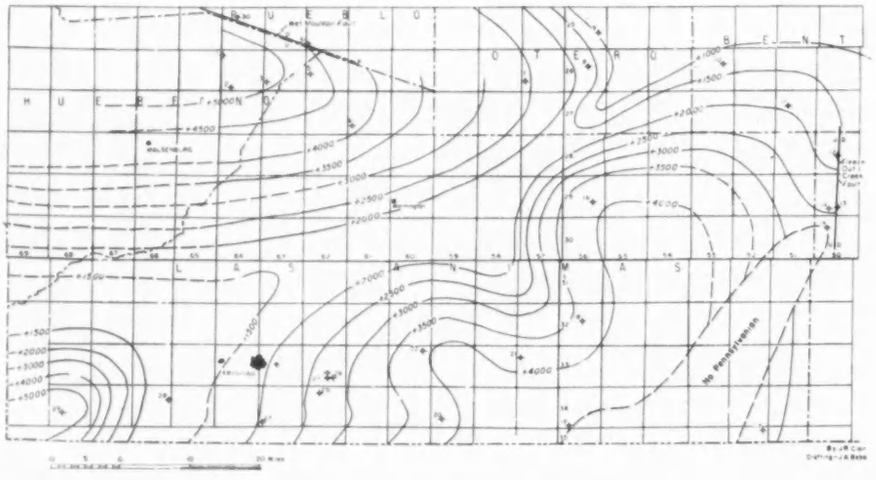

FIGURE 4—This structure map of the area was prepared with the top of the Pennsylvanian system used as a datum. Contour interval is 500 and 1000 feet.

was red sandy limestone 105 feet thick, and red arkose 725 feet thick. The well probably bottomed in the upper part of the Sangre de Cristo formation of Pennsylvanian age, though no samples are available to substantiate this. The well was abandoned but later the field was drilled up and sold to the U.S. government for a helium reserve. The gas is unusual since it contains no hydrocarbons and has an extremely high helium content.

The area under discussion has had only six tests which have penetrated the Pre-Cambrian.

Structural aspects. Figures 1, 2 and 4 show the subsurface structural picture as presently developed. Figures 3 and 5 show the isopach data for Arbuckle and Pennsylvanian sections. It is possible to delineate only broad structural features since subsurface control is lacking. Relationship of these features to possible oil and gas accumulation will be discussed later.

Tectonic and depositional history. Much has been written on the tectonic and depositional history of the region. (See references.) For the most part the author is in general agreement with this postulated history; however, there are several minor factors having a direct bearing on the area with which the author is in disagreement.

Detailed sample and paleogeological studies indicate Arbuckle rocks of the area were deposited in a shallow re-entrant where the Sierra Grande-Apishapa axis curved southward (Figure 2). The area remained positive from the close of Cambro-Ordovician to late Pennsylvanian time, though Mississippian seas did overlap on the edges of the uplift and were beveled somewhat by post Mississippian erosion.

In early Des Moinesian time, an arm of the Colorado trough extended northeastward and eastward into the area but did not join at that time with the Anadarko-Hugoton seaway. Intermingling of these two troughs finally took place during Missourian-Virgilian time through the above indicated re-entrant, though portions of the Sierra Grande-Apishapa were still positive and supplying coarse arkosic sediments. It is believed that all of the Sangre de Cristo of this area is Missourian and Virgilian. This is con-

trary to most published material but better fits the data gained from this study.

Oil and gas potential. Facts indicate that the Colorado portion of the Raton Basin has considerable potential for oil and gas based on sample studies. Furthermore, it appears that the northeast quadrant of this area has the greatest potential.

Presence of Arbuckle rocks in this area has been known for many years, but their significance has been ignored or disregarded. The author realized this relationship while supervising the drilling of the Pauley et al Daugherty 1 in Section 15-T32S-R56W (Well 18 on maps).

The abrupt apperance of Ordovician rocks in an area considered completely devoid of beds of this age resulted in re-evaluation of the area and the realization of the significance of their appearance. Figures 2 and 3 show the present structural relationship and thickness of the Cambro-Ordovician rocks in the area. The dashed line on Figure 3 shows the present subsurface extent of Mississippian rocks. Here is an area in which Arbuckle beds are in direct contact with overlying Pennsylvanian beds. This is exactly the condition over the major portion of the producing area of the Central Kansas uplift.

Furthermore, this area is coupled with a major regional positive axis or axes (Sierra Grande-Apishapa), which again is correlative with the condition in Kansas. The structural attitude indicates that these beds have definitely been folded. Also, evidence exists that they have been subject to erosion and, consequently, probable development of secondary porosity has occurred like that found in the Arbuckle rocks along the Central Kansas uplift. The author suggests that the outlined conditions are present in the area and that, by analogy, the area has great possibility of having oil or gas in Arbuckle rocks. It must be pointed out that the highest well, structurally, overlies a buried Pre-Cambrian knob. However, some of the best Arbuckle production in Barton County, Kansas, has been obtained on the flanks of such buried features.

It has been postulated that during Missourian and Virgilian time the seas of the Raton Basin mingled with those of the Hugoton embayment through the trough shown on Figures 1, 4 and 5. Sample investigation shows that the coarse, arkosic sandstones are becoming cleaner and are more or less winnowed of the contaminating shales and other porosity destroying sediments. Further, the section is thickening rapidly from southwest to northeast along this trough in the area of interest (cross-section A-A′ Figure 7).

Additionally, during Missourian and Virgilian time marine waters were more widespread and the limestone and shale sequence of the Hugoton embayment interfingers with the coarse arkoses on the flanks and in the trough through the Sierra Grande-Apishapa axis. Excellent shows were encountered in this section in the Gaulke 1, C/NE/NE of Section 15-T26S-R56W (Well 8). However, drillstem tests were run below the zones where shows were encountered. It is suggested that this entire sequence of coarse, arkosic sands with interfingering marine limes and shales in a proven marine environment parallels closely the relationship that is found in the Elk City area of the Anadarko basin in Oklahoma.

Investigation of the Pennsylvanian structure map (Figure 4) reveals sharp northwestward pull-outs which indicate that folding is definitely present in the area. Admittedly, the highest points are over buried Pre-Cambrian knobs, but the author suggests that they indicate erosional remnants along old fold axes.

Presence of commercial helium gas from the Glorietta (Lyons) sandstone

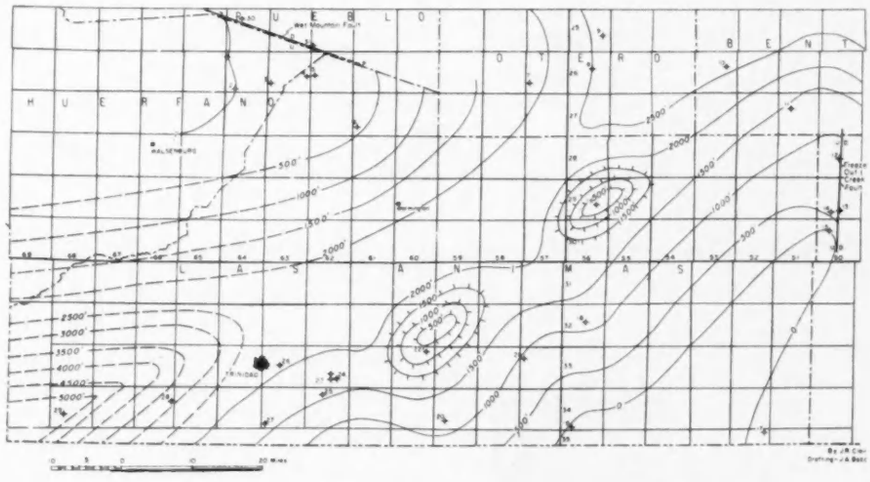

FIGURE 5—The thickness of Pennsylvania rocks was used as a datum preparing this isopachous map of the basin. Contour interval is 500 feet.

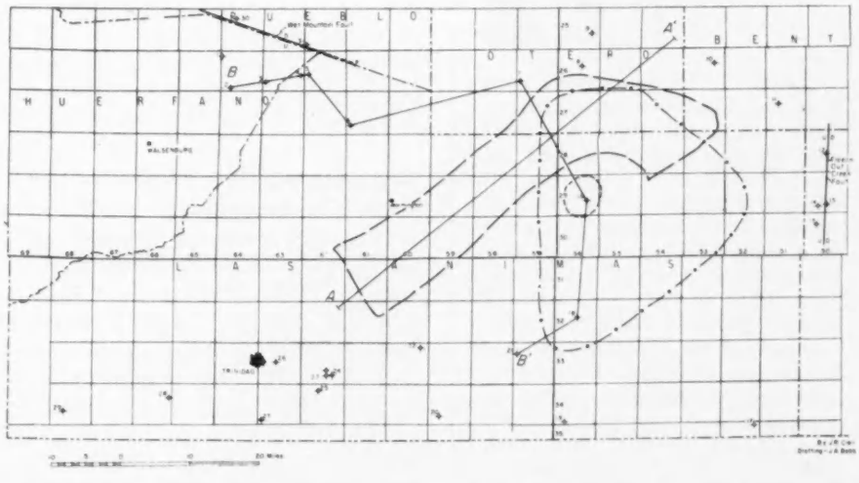

FIGURE 6—The areas outlined here indicate the portions of the area which have the greatest potential for commercial oil and gas production. The Pennsylvania possibilities lie in the trough area where the section is thickening rapidly and where the greatest interfingering of the seas from the Hugoton embayment might be expected.

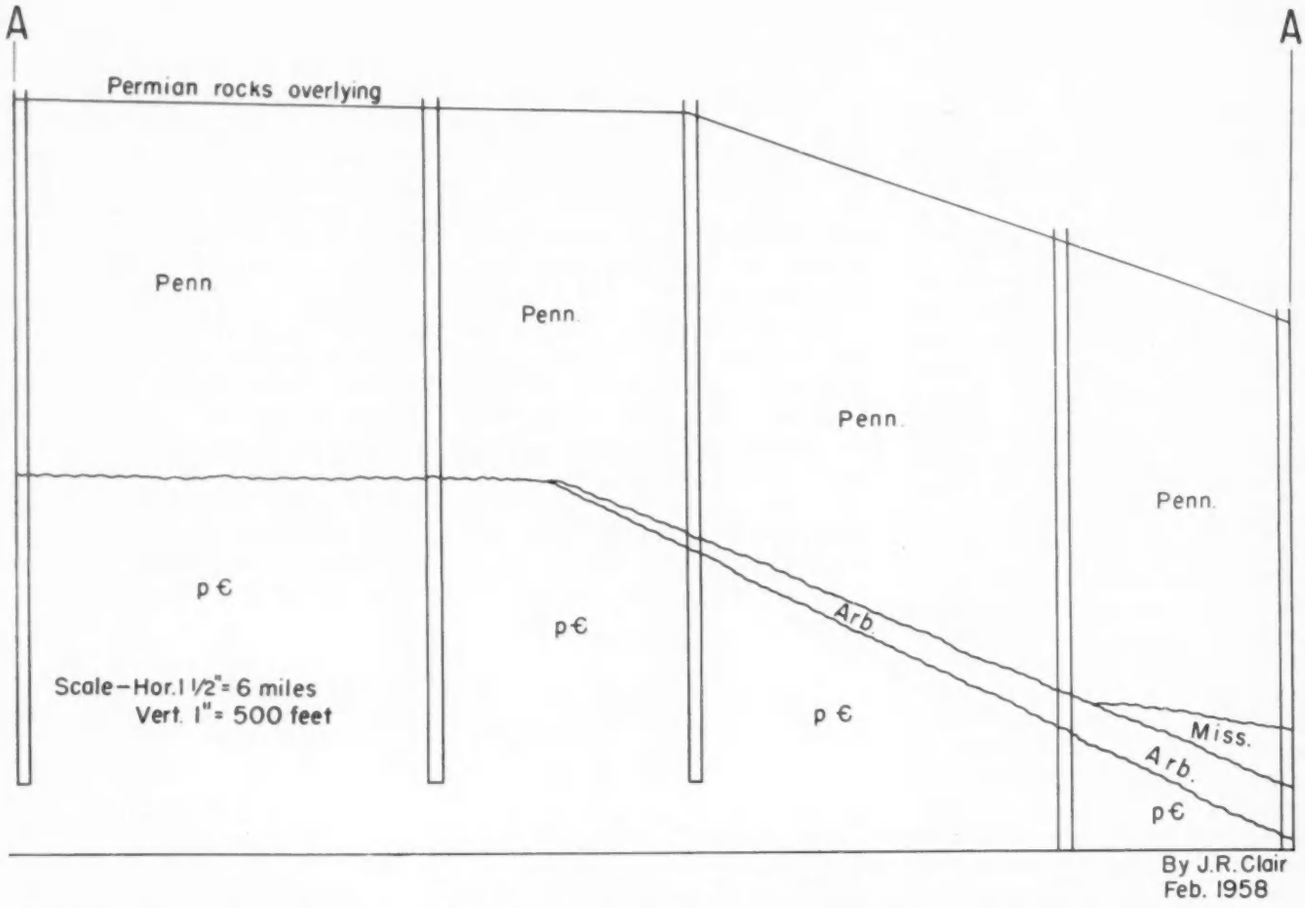

FIGURE 7—This diagrammatic cross section (Line A - A', Figure 6) thickens rapidly from SW to NE along trough area.

About the Author

Joseph R. Clair was graduated from the University of Kansas in 1933 with an A.B. degree in geology and did post-graduate studies for his M.S. and Ph.D. degrees at the Missouri School of Mines and University of North Carolina. He worked as a surface geologist for the Missouri-Kansas Pipe Line Company from 1929 to 1931 and was appointed geologist—water resources, gas and oil, for the Missouri Geological Survey in 1933. He has been associated in various geological capacities with Skelly Oil Company, Great Lakes Carbon Corporation and Denver Sample Log Company. In 1953 he became an independent geological consultant specializing in the Southern Rocky Mountains area.

on the Model anticline indicates that other structures within the area might be productive in the same horizon. In the Denver basin, commercial production has been established in the Lyons under conditions similar to those which must have existed in the subject area. Though subsurface data is so meager it is impossible to pin-point any local structures, it is probable that they are present in the area. This would add another potential producing horizon to any proposed test in the area.

Area for possible future exploration. The area outlined by hachures on Figure 6 holds the greatest promise for potential oil production from Cambro-Ordovician rocks. There is definable folding; potential reservoirs are not beneath Mississippian cover and are in direct contact with overlying Pennsylvanian rocks. Definable porosity has been developed in the Arbuckle sequence. Furthermore, the overlying Pennsylvanian sequence also has some potential.

The area outlined by dashed line on Figure 6 has the greatest potential for production from Pennsylvanian rocks. Sample investigation indicates that the arkosic sands are becoming cleaner in this area and it is peripheral to two indicated fold axes. The rapid thinning onto these folds provides optimum conditions for pinchout of sands and consequent development of stratigraphic traps.

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PART 1

How to appraise wildcat prospects

Using this method over a two-year period, the author's company had a 1 to 1.7 ratio of profitable fields to total fields discovered

By George C. Hardin, Jr., Exploration and Production Manager
Michel T. Halbouty Oil and Gas Interests
Houston

THE SEARCH for new oil and gas reserves can be called a "gamble" in the truest sense of the word.

The odds against the operator can be decreased, or made more favorable by the competency of his geological staff, but they still will be very much against finding a profitable oil field with any one new field wildcat. To be successful over the long pull, the ratio of the value of expected oil or gas from each wildcat prospect drilled, to the total cost of the prospect must exceed the ratio of successful wildcats to unsuccessful ones in the operator's individual case.

It is true that an operator may drill a few productive new field wildcats where expected profit after discovery is only 5 or 10 times the cost of the prospect—and he may be apparently successful. However, if he stays in oil exploration and continues to drill such prospects, he will not be successful unless his program is completely financed by outside capital.

Success-to-failure ratio. Exploratory drilling statistics show the average discovery rate for new field wildcats drilled in the United States to range from a low of 10.7 percent to a high of 12.2 percent over the last 13 years.[1] Based on this almost constant ratio of success-to-failure, it can be assumed that an average of 1 wildcat in 9 drilled in the United States will produce.

For the years 1956 and 1957, the writer's company operated under the approach described in this two-part series. Result:

- **Two unprofitable fields were found out of six discoveries by new field wildcats.**
- **Two unprofitable fields were found out of four discoveries by new pool wildcats.**
- **The ratio of profitable fields to total fields discovered was approximately 1 to 1.7.**

It is the author's opinion that this favorable ratio was largely the result of the approach used in evaluating the economics of the prospects. Next month, ways to estimate possible profit and permissible tolerances will be presented, plus some excellent examples of prospect evaluation.

As of 1956, 16 percent of the wildcats were drilled without the aid of geological or geophysical advice. Assume that an additional 29 percent of the wildcats, although drilled on some form of technical advice, were not drilled on prospects with sufficient control or merit to warrant a drilling recommendation by most competent geologists. Under this assumption, wildcats drilled with the advice of experienced geologists would have an expected success-to-failure ratio of approximately 1 in 5 under ordinary circumstances.

Statistical figures also show that only 1 in 5 successful new field wildcats finds a profitable field (a field with a reserve of a million barrels or more).

These statistics make it apparent that the competent geologist can expect to average finding only one profitable oil field out of each 25 new field wildcats drilled. It is obvious that if an operating company cannot improve this ratio, it either has to be spending outside risk money, or it soon will be out of business. How, then,

"A minimum monetary return expected from any successful new field wildcat drilled should be set at 50 to 1."

can this ratio be improved?

The answer lies not so much in improving the 1-to-5 discovery rate expected, but in improving the 1-to-5 ratio of profitable fields to total new fields found. This ratio improvement must be accomplished by correlating the geological and economic aspects of all prospects, and drilling only those that give promise of producing sufficient oil and/or gas to compensate for the dry holes that inevitably will be drilled.

By drilling only those prospects that offer an adequate possible return in relation to the risk, the ratio of profitable fields to total new fields found should be improved to 1-in-2 or 3.

This article is concerned primarily with new field wildcats, but new pool wildcats will be discussed. No consideration has been given to extension (outpost) tests, deeper-pool tests, or shallower-pool tests.[2]

Profit-to-risk ratio. In the operation of an oil company, the success-to-failure ratio is reduced to dollars in the ultimate analysis. With an average chance of only 1 in 25 of finding a profitable oil field, everything possible must be done to guarantee that the company's interest in the one profitable field will be large enough to more than compensate for the cost of the other 24.

For this reason, a minimum monetary return expected from any successful new field wildcat drilled (the profit-to-risk ratio) should be set at 50 to 1. Why? Assuming the recovery per acre to be comparable to similar producing structures along the same trend, then the ultimate net return expected from production from the available acreage should be at least 50 times the total cost of the prospect (total amount of money risked), or the drilling of the well is not economically sound. The exploratory well is not expected to produce this amount of oil, but the total ultimate net income that should result from a discovery by a new field wildcat (after deducting development and operating expenses) should exceed 50 times the total amount risked on the prospect. This relationship will be called the profit-to-risk ratio.

Prospects on which new pool wildcats are to be drilled should be evaluated on approximately the same basis as new field wildcats, but the acceptable profit-to-risk ratio for new pool wildcats is somewhat lower than for new field wildcats.

The method of prospect evaluation described places emphasis on the possible ultimate recovery from prospective acreage rather than on the amount of acreage available. While it is true that the larger the prospective acreage spread, the larger the profit-to-risk ratio will be, it is also true that small blocks of acreage where thick productive sand sections are expected often have a higher profit-to-risk ratio than larger blocks above thin sands.

Because of development costs, it is obvious that 50 net feet of sand under 200 acres will be more profitable than 10 net feet of sand under 1000 acres.

Estimating cost or risk. In estimating the cost of a prospect, or risk, all cost items attributable to the prospect should be considered. In addition to the bonus cost of the leases and the cost of the exploratory well, legal costs, brokerage costs and overhead also must be included. Exploration overhead often is not included when computing costs. However, the total exploration overhead of an office can be justified only by allocating a proportionate part of the annual overhead to each of the acceptable prospects acquired during the year. In general, for prospects initiated by an operating company, the exploration overhead cost will range between $25,000 and $50,000 per prospect.

For some major companies where a large exploration staff is maintained and relatively few exploratory wells are drilled, overhead cost per prospect might exceed $100,000. When blocks of acreage are bought as a package or taken as a farmout after others have obtained the leases and assembled geological and/or geophysical information, a proportionate part of annual exploration overhead should be allocated to the prospect based on the amount of time spent on the prospect by the staff.

In estimating the cost of development, the lease situation must be given careful consideration. In areas of small tracts, lack of pooling provisions in the leases may make it obvious that even in the event of a discovery, the field could not be developed profitably. In Louisiana, where pooling can be forced by the Conservation Commission, this consideration is not so important. In most other states, pooling must be voluntary.

The cost of drilling and completing development wells generally constitutes most of the development cost. However, in some instances where there are a large number of small tracts and titles are poor, legal fees can approach, if not exceed well costs. This situation should be analyzed and an estimate of this cost added to the estimated cost of development.

Another important factor to be considered is the risk of dry holes during development. If, in other fields on similar structures along the same trend as the prospect, there have been a number of dry holes drilled during the development of the fields after discovery, then this additional cost should be added to estimated development costs.

(TO BE CONTINUED)

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Congress to increase oil industry probes

Here is the outlook for depletion, imports, natural gas, and public lands as reported by a top Washington consultant

By Ira P. Bradford
Consultant to Extractive Industries
Washington, D. C.

WITH SEVERAL frontal attacks on the oil industry at the very outset of Congress, particularly in respect to depletion, there is no doubt that the industry will be called upon later before several committees to be heard on imports, public lands leases and uses, foreign oil agreements, foreign credit, increased gasoline taxes, plus a possible reappraisal of the natural gas act and the need for amendment.

The steadily increasing cost of operating the federal government again makes it necessary for Congress to examine all phases of the economy to find spots to tap for additional taxes. Because increased tax burdens tend to stifle incentives for new business ventures and, according to Washington tax experts, have hastened the merger of individually or family owned enterprises with large corporate entities, the Congress has devoted more and more time to study of the existing tax units, privileges and subsidies in our laws.

To the oil and gas industry this means a fight to retain the depletion provision at the present level.

Although the Congress has held to the incentive principle and to the rate of 27.5 percent since 1926, pressures have built up in recent years from the liberal blocs in both House and Senate to reduce, if not eliminate, the provision. These liberals come mostly from states having no oil or gas production, and so are comparatively free from political retribution on the part of voters whose livelihoods are not directly affected. Depletion opponents were to garner 31 votes against the provision last year.

Even though the Democrats have increased their edge in the Senate substantially, analysts do not think the forces in opposition to the depletion provision have increased their vote by more than three.

In the House there would likely be a very close fight should the depletion bill get to the floor, but present thinking is that in the calmer atmosphere of the Ways and Means Committee, a long and careful study of the real problems involved will prevent floor consideration of depletion legislation this year.

The President's budget message carries a specific recommendation from the Treasury Department for an amendment to the tax law defining the application of percentage depletion to process materials and the treatment of the sales price of such finished products. While this in itself is of no interest to the petroleum industry it does broaden the subject and is another avenue by which the whole problem may be reopened.

Import Controls. It appears that some aspects of the imports problem will be settled this month—with mandatory controls.

In the face of this development, international operators have run into a rash of new demands from heads of foreign governments calling for a larger share of the take from their rich oil property. For example, an increased tax in Venezuela on the production of crude oil retroactive to the first of 1958 has imposed a heavy burden on the long established producers. After new producers write off cost of concessions, they too must shoulder the burden.

This action on the part of Venezuela brought forth words of approval from Signor Mattei, Italian government oil czar, lauding the recognition of the need of granting larger shares to oil holding countries even up to 75 percent, leaving 25 percent to the concession holder. Thus, the need to extract and dispose of the foreign crude to insure profitable payouts places a further burden on operators to find markets, and to increase imports to this country if possible.

Senator O'Mahoney has made known his knowledge of the import problem and has stated publicly that he will conduct an investigation into all factors and the effect they may have on the economy. Because of his previously expressed interest in the foreign aspects of oil production and his historic interest in Cartels, consortiums, and other contractual agreements involving so called big business and foreign governments, this investigation could assume the proportions of another T.N.E.C.

Natural Gas Legislation. Although only mild interest can be evoked on the chances of any natural gas act legislation, Chairman Oren Harris (D-Ark.) has introduced a new bill to amend the act.

The new bill follows the lines of its predecessors, with the exception that it does include the anti-dumping amendment proposed by Congressman Staggers of West Virginia last session. The additional clause would make direct sales of gas for industrial uses subject to the control of the Federal Power Commission. Inclusion of that amendment is said to be a bid for the support of the coal industry for the passage of the bill.

It is thought by some supporters of the bill that while inclusion of the amendment may enlist help for the passage of the bill from the coal industry, it may very well mean the loss of support by the gas transmission people.

Other analysts declare that the gas lines representatives have cooled to an all out fight for a natural gas act amendment since the overturning of

the Memphis Decision by the Supreme Court. With that victory under their belts, the gas transmission people are believed to be reluctant about reopening the subject of amending the natural gas act.

An important factor in reviving interest in the natural gas act would be an outright request for new legislation from the White House—and a move of that kind is being predicted now.

Public Lands. The most recent development concerning federal public lands is the formally announced intention of the Secretary of Interior to crack down on individual corporations for alleged illegal acquisition of federal oil and gas leases.

Several major oil companies are said to be involved and it is rumored that the Secretary will call for the cancellation of some of their leases and the mineral leasing law which provides that no person or company may hold more than 46,080 acres in federal oil and gas leases in any one state or more than 100,000 acres in the new state of Alaska.

The new regulations also provide that the Bureau of Land Management may require any one applying for a lease to file a statement making full disclosure of his entire lease holdings, and this includes leases in which he may have only a partial or indirect interest.

For some time, several senators have expressed an interest in tightening up leasing requirements. Thus, it may be expected that if the Secretary of Interior starts cracking down on lease applicants, particularly on individuals, the Congress will call for an investigation into the entire subject of the administration of the mineral leasing laws past and present.

Foreign Credits. One of the several alleged benefits enjoyed by American firms operating overseas is their treatment of foreign credits. Chairman Boggs of a sub-committee of the Ways and Means Committee will continue his study of the matter, and it is understood that he favors a broadening of the use of foreign credits.

Tidelands. The controversy regarding offshore lands of Louisiana is still before the U.S. Supreme Court. The court has invited representatives of the other interested states (Alabama, Mississippi and Texas) to be heard. There has been no talk of any legislation on the tidelands in this session of Congress. —**The End**

Earnings outlook promising after good fourth quarter

By L. J. Logan
Associate Editor, WORLD OIL

EARNINGS IN the oil industry continued to improve in the fourth quarter of 1958. Net income was larger than in the third quarter for a large majority of companies. Those results followed a relatively good third quarter, in which earnings were generally improved over poor first and second quarters of 1958.

Some companies showed less profit in the fourth quarter than in the third. But in some cases, the decreases were small, and the final quarter results still were comparatively good. In other instances, the indicated declines in earnings resulted from year-end adjustments. Those accounting changes included the heavy charges against 1958 earnings made by large Venezuelan operators to cover the retroactive increase in Venezuelan taxes. Especially hard hit were Creole Petroleum Corporation and its principal owner, Standard Oil Company (New Jersey).

It is indicated that oil industry earnings will continue generally good in 1959. Companies will do increased volumes of business. They will produce, refine and sell substantially more oils in 1959 than in 1958. Demand for petroleum will be up about 4 percent in the United States and about 8 percent in other free countries.

World-wide over-supplies of oils currently are depressing the crude oil markets. Crude prices in recent months have been marked down around 7 cents a barrel in large areas of the United States, 5 to 15 cents a barrel in Venezuela, and 18 cents a barrel in the Middle East. But prices of refined products have shown some improvement and so far remain firm. Larger volumes of business will help to compensate for declines in crude prices.

For internationally operating companies, there is some danger that increased taxes, as in Venezuela, may spread to Middle Eastern and other oil producing countries.

Net Earnings of Some Oil Companies in 4th Quarter and Year, 1958 vs. 1957

(All "per share" data are based on the number of shares of common stock outstanding Dec. 31, 1958)

	4TH QUARTER					YEAR				
	$ Thousand		$ Per Share		%	$ Thousand		$ Per Share		%
COMPANY	1958	1957	1958	1957	Diff.	1958	1957	1958	1957	Diff.
Anderson-Prich	1,043	1,168	0.60	0.65	— 11	3,800	5,243	2.08	2.93	—28
Ashland O. & R.	3,232	3,575	0.49	0.55	— 10	9,989	15,544	1.60	2.57	—36
Atlantic Ref. Co.	14,645	6,376	1.59	0.71	+130	33,825	35,670	3.61	3.97	— 5
Bishop Oil Co.	70	105	0.12	0.18	— 33	169	267	0.30	0.47	—36
Continental Oil	14,206	11,862	0.72	0.60	+ 20	47,500	46,724	2.41	2.38	+ 2
*Creole Pet. Corp.	d10,018	78,193	d0.13	1.01	....	239,000	397,000	3.08	5.11	—40
*Imperial Oil	16,173	13,660	0.51	0.43	+ 18	50,500	72,081	1.60	2.29	—30
Leonard Refineries	291	468	0.26	0.42	— 38	1,488	2,126	1.33	1.90	—30
Maracaibo Oil	119	124	0.24	0.25	— 4	337	†530	0.69	†1.08	—36
Ohio Oil Co.	9,128	9,483	0.69	0.72	— 4	32,156	41,490	2.45	3.16	—22
Phillips Pet. Co.	26,591	21,982	0.77	0.64	+ 21	84,200	96,209	2.45	2.80	—12
Plymouth Oil Co.	1,712	372	0.64	0.11	+360	4,588	6,027	1.79	2.40	—24
Shell Oil Co.	38,211	29,287	1.26	0.97	+ 30	116,500	135,085	3.85	4.46	—14
Sinclair Oil Corp.	14,132	16,429	0.92	1.07	— 14	49,500	†75,338	3.23	†4.92	—34
Standard, Calif.	70,256	76,465	1.11	1.21	— 8	258,000	288,230	4.08	4.56	—10
Standard, Ind.	31,351	37,637	0.88	1.05	— 17	117,800	151,509	3.29	4.24	—22
Standard, Ky.	3,611	3,067	1.39	1.17	+ 18	14,053	12,626	5.40	4.85	+11
Standard, N.J.	102,000	145,177	0.49	0.70	— 30	564,000	805,177	2.73	3.89	—30
Standard, Ohio	6,570	9,338	1.32	1.89	— 30	‡24,044	‡23,920	‡4.82	‡4.79	....
Sun Oil Co.	9,439	8,479	0.80	0.72	+ 11	32,061	47,492	2.73	4.04	—32
Sunray Mid-Cont.	9,369	12,155	0.54	0.65	— 23	34,700	†48,083	2.00	†2.57	—28
Texas Gulf Prod.	1,116	1,482	0.28	0.37	— 25	3,640	6,442	0.90	1.60	—43
Texas Pac. C. & O.	2,065	1,717	0.53	0.44	+ 20	6,231	7,232	1.61	1.87	—14
Tidewater Oil Co.	2,928	8,946	0.16	0.62	— 67	2,600	34,937	...	2.42	—93
*Total 22 Companies	362,085	405,694	.....	.....	— 11	1,441,181	1,885,901	.....	.....	—24

* Creole and Imperial are excluded from totals, being included as affiliates of Standard (N.J.)
† Excludes non-recurring profit. ‡ Includes non-recurring profit. d Deficit.

This fold-out rack reduces cost of moving rig paneling

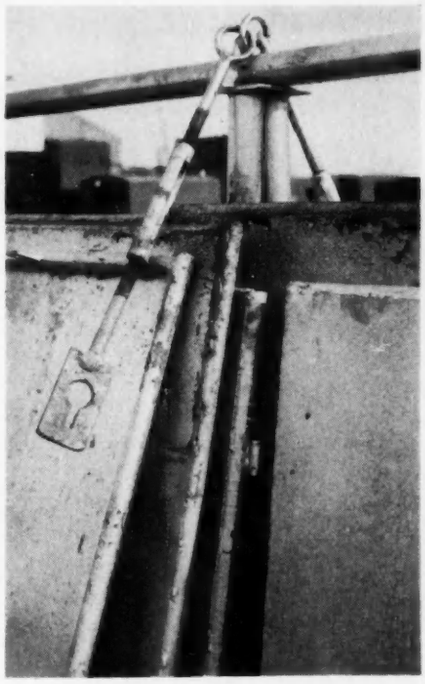


FIGURE 1—Turnbuckles at mid-point of center section are modified to permit cinching—and holding—chain to nearest link, after which turnbuckles are tightened to cinch load for transporting.

THE SAFE STORAGE and transportation of light weight but bulky rig winterizing panels are problems made difficult by the number and sometimes odd sizes of panels usually involved. However, these problems can be solved to a large extent by the use of a bookcase type rack—one that folds out when on location but which can be cinched shut firmly when moving.

Designed to handle as a single package all unitized panel sections used on the rig floor, the rack is built of used drill pipe and 2-inch line pipe. Several turnbuckles and a half-dozen short lengths of chain make up most of the remainder of the materials involved.

The basic structure is a platform 8 feet wide by 15 feet long. The two 15-foot long outboard stringers are of 4½-inch drill pipe and the 8-foot cross members are of 2-inch pipe. The 2-inch members, spaced several feet apart, provide the "floor" on which rest the panels. Rising from the center of the platform and running its full length is an A-shaped structure 6 feet high, also of 2-inch pipe, which forms the backbone of the rack. Structure legs are about 1 foot apart at the base. They are welded together at a common point at the apex, where they are capped by a steel plate. Running the full length of this center section is a 2-inch stringer which also serves as a bail when the unit is lifted by an A-frame, or crane.

Rack sides, consisting of four 4-foot lengths of 2-inch pipe topped by a 15-foot length of 3-inch material, are designed to fold outward and lie flat on the ground, facilitating the job of stacking and removing the panel sections. Each of the 2-inch members is attached at the 4½-inch base member by a pinned connection which serves as a hinge.

At each end, and at the mid-point of the rack sides, are welded steel eyes to which are attached short pieces of chain, the latter being from 2 to 3 feet in length.

Tightened with turnbuckles. At the mid-point of the stringer running along the rack center section is another ring to which are attached two turnbuckles, each equipped with a modified end and key-hole type opening which permits attachment of chain.

When the rack is filled and ready to be closed, the side members are raised and pushed inward tightly while a man loops the corresponding chains through the center turnbuckles, taking up as much slack as he can. Similarly, the end chains are brought around the ends of the rack and pulled together tightly; these being intended to prevent panels from slipping out the end of the rack should it be tilted while loading aboard a truck. Tightening the turnbuckles pulls the panels in against the center section and makes the load compact and secure for transporting.

This type of rack, built in this instance for winterizing siding, can easily be adapted to the carrying of similar flat materials used elsewhere around the rig and location, such as knocked-down shelters, engine house roof sections, etc. It is light in weight, easily constructed by any welder out of used materials. Ability to pick up and transport an entire stack of panels in a single load will result in substantial savings each time the rig is moved. Too, the panels, built and "tailored" to a particular rig at considerable cost, will suffer a minimum of damage in transporting. Also, little or no time is lost when they are installed on the next location.

FIGURE 2—Rack, at location, folds outward for easy access to individual panels, simplifies stacking when moving to next location. Note short chains, at ends and mid-points, which provide flexibility in tightening side members when rack is loaded.

Platform during the first piling phase, in offshore drilling of a Shell Group company in the South China Sea.

Offshore work proceeds in South China Sea

Royal Dutch Shell companies seek new reserves as Seria development moves offshore. Rapid sea seismic surveys evaluate prospects, as rigs are designed for 150-foot depths of water, braving typhoons.

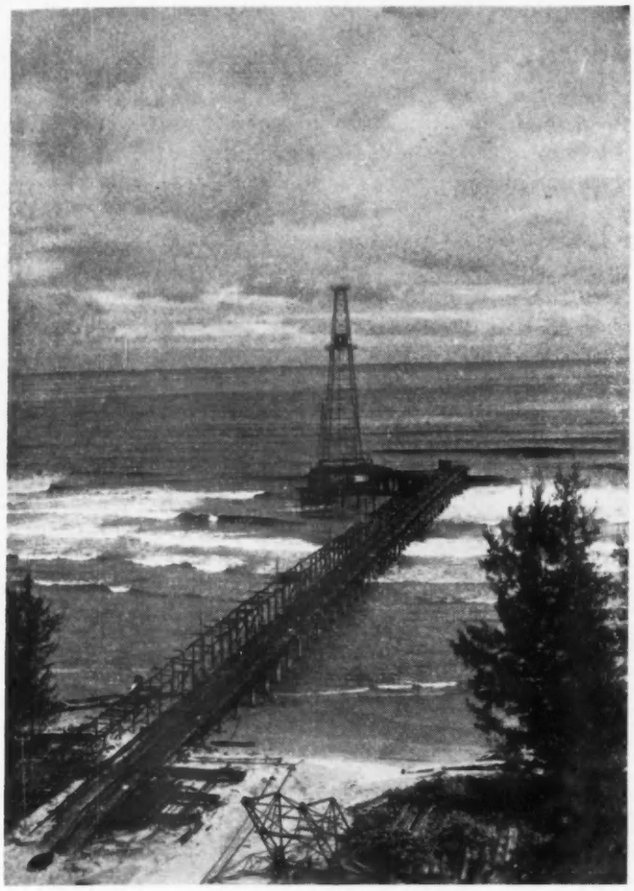
Drilling platform of Brunei Shell Petroleum Company Limited at a marine location on the high seas off Seria, Borneo.

SURRENDER OF the Shell Group's 36,650 square mile concession in Sarawak, British Borneo, over a year ago highlighted growing seismic evaluation activity in offshore drilling in the South China Sea.

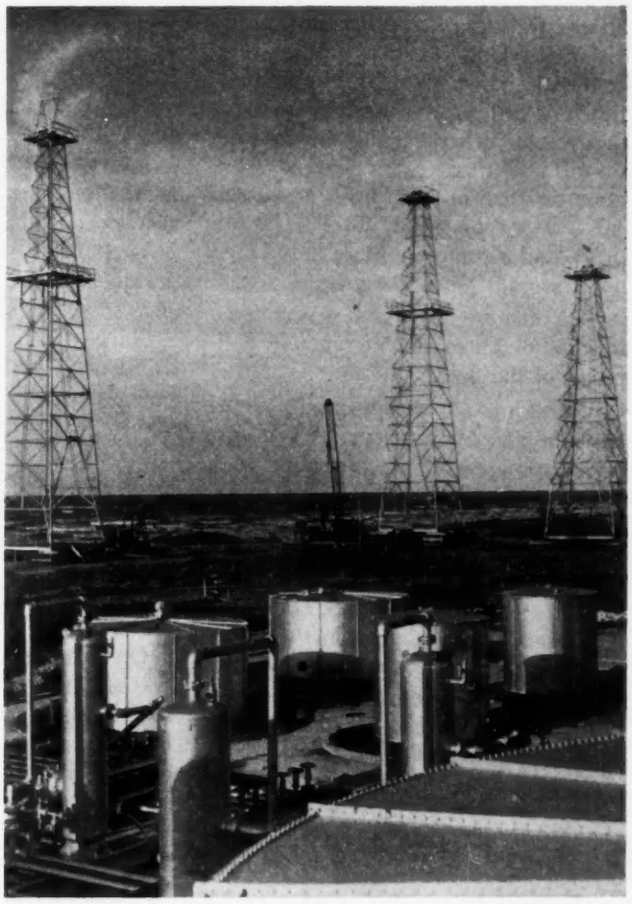
Following a number of attempts to drill from fixed platforms off the coast of Sarawak, Brunei and North Borneo, the Royal Dutch Shell Companies undertook to employ a mobile platform that was built for the DeLong Corporation in Southampton, England.

Completed during the summer of 1958, this was the first mobile drilling platform to be built in the United Kingdom.

Designed to operate in depths up to 150 feet, the 3,000-ton platform measured 200 feet by 100 feet, with accommodations for a crew of 30. The platform supported its own generators, drilling rig and mud hoppers. The outfit was capable of drilling to 15,000



A producing well of Brunei Shell Petroleum Company Limited located offshore from the Seria field. Sultanate of Brunei, British Borneo. This was one of the few marine wells drilled in this area before the war. Plans are to extend sea drilling operations in the future.



Wells along the sea shore in the Seria field, Brunei. A block station in the foreground receives the crude oil from the wells. From Seria the oil is moved by Brunei Shell Petroleum Company Limited to the Lutong refinery, in Sarawak, for processing.

feet. It cost more than $1 million.

Three Royal Dutch Shell companies operate in the Borneo area: Sarawak Oilfields Limited, producing Miri field at the rate of 1,275 barrels per day; Brunei Shell Petroleum Company Limited, operating the Seria oil field, the largest in the British Commonwealth, yielding at the rate of 110,000 barrels per day; and Shell Company of North Borneo Limited.

First indication of offshore deposits came before the war at Seria, where an undersea extension of the field was discovered by deviated wells from land and by using platforms erected in shallow waters inshore. In 1952 fixed platforms were set up about one mile offshore, each capable of supporting four wells, one vertical and three deviated. Some of these platforms were linked with the shore by aerial ropeway. However, production from these wells still amounts to only about 1,200 barrels per day. More platforms are being installed to continue development of the seaward extension of the Seria field.

Geophysical work. Between 1954 and 1956 the three companies combined to carry out a geophysical survey covering an area of 30,000 square miles offshore. Methods used were reflection seismic (some 8,000 miles of line) and remote control gravimeter (2,100 stations), combined with sea bed sampling using a drop core. Operations were confined to the March-November period, to avoid the northeast monsoons, which make continuous operations impracticable at other times of the year.

In 1954 and 1955 a British party from Seismograph Service Limited carried out surveys using a converted small coastal vessel in the first year, together with sea-going launches as shooting boats. In the following year a specially converted corvette was used, as a one-boat operation for at least part of the time. A Shell group seismographic party became available in 1956 with the specially built M.V. "Prospector" for towing cable and recording. A 60-ton motor vessel served as shooting boat. In the Seismograph Service survey the Lorac system was used for location. The Shell party employed the Decca radiolocation system.

The gravity survey, from a small local sea-going 60-ton vessel, was carried out in 1955 and 1956 with a remotely controlled North American gravimeter. In addition, a locally-built drop corer was mounted on this vessel, and a sea-bed sample was obtained at each gravity station. In an average day's shooting, coverage of about 30 miles of reflection line was obtained. About 12 gravity stations per day were observed on a three-mile grid, including sea-bed sampling.

Good records obtained. General quality of records was good and incoming records were brought regularly from the seismic vessels by launch or helicopter to a computing and review team at the Seria office. This provided

an expanding and up-to-date picture on which long range planning could be based and which also allowed modifications to the program as the survey progressed. Wherever possible a close-tie-up was made with seismic work done on land or with known geological sections on land. Shallow water prevented a complete tie in most cases, but the gaps were not critical.

The offshore Seria area was covered in some detail to aid the seaward definition of the field.

The Ampa 1 was located on the basis of reflection seismic work carried out in the 1954 campaign on a coral patch about 25 miles offshore, lying 30 feet below the surface of the sea. This well was drilled from a locally-built template type of platform, using a rig made by a U. S. company. After seven months' drilling the well was abandoned as a dry hole at a total depth of 5,985 feet. A thick section of heaving plastic clay shale had made for slow progress. Results of this drilling emphasized the high stratigraphic risk factor of exploration wells distant from known geology. Rapid facies changes characteristic of the younger Tertiary of the north-west Borneo basin make uncertain any extrapolation based on seismic data from known geology on land.

Siwa 1 in offshore Sarawak, about 15 miles southwest of the Miri field was located on the basis of reflection seismic carried out in 1955. A template-type platform similar to the one used at Ampa was set up in 70 feet of water. The first well drilled vertically to a total depth of 7,680 feet was abandoned as a dry hole. The second well, deviated at an angle of 30 degrees to the west, was also abandoned as a dry hole at 5,036 feet. Information obtained here will be used to help extend geological control of offshore seismic data.

The third fixed platform well at Hankin shoals, some 30 miles north of Labuan in North Borneo waters, was located on the basis of geophysical information obtained during the 1955 and 1956 campaigns. It was situated near a coral reef complex in 30 feet of water and was drilled during 1958. This well completed the fixed platform program, which involved expenditure in excess of $3 million. Both the Ampa patches and Siwa platforms were left in position with the rigs removed to new locations.

—**The End**

Third Test on Structure In Libya Is Unproductive

Oasis Oil Company's third test on Block 32 in Libya has been abandoned as a dry hole. It was a stepout on the southwest flank of the same structure proven oil-bearing by two previous tests. It ran about 100 feet low structurally, but encountered good oil shows.

Neither of the two oil wells of Oasis on Block 32 will flow. But some gas was encountered in the second test. The first well, Bahi 1, is 70 miles south of the Gulf of Sirte and 200 air miles southwest of Benghazi. The interval at 5,822-5,854 feet was tested in open hole. The drill pipe filled with 30 gravity oil on a ¼ inch bottom choke. The pay zone is a sand, possibly of Cretaceous age.

Oasis moved the rig 24 miles south and slightly east of the discovery well to drill Dahra B1-32, believed to be on the same structure. It tested 36 gravity oil from limestone at 3,758-3,808 feet, and later was drilling at 5,930 feet in hard quartzite, thought to overlie basement. The oil bearing limestone found there was absent in Bahi 1. Likewise, the sandstone pay found in Bahi 1 was absent in the second test. The rig was then moved about five miles north and slightly west of the Dahra well for the third test of the structure.

Oasis expects to run three rigs in Libya in 1959. Two will be used on Block 32. One will be used to drill a wildcat in the Fezzan in the southeast part of Block 26. This location will be northeast of a recent test drilled by Compagnie des Petroles Total (Libye) on its Block 49, which reportedly tested oil at about 4,700 feet.

Large Field in Algeria Extended 37 Miles North

Hassi R'Mel gas-condensate field in Algeria, already a major one, was apparently extended about 37 miles north late in 1958. A wildcat found 100 feet of gas sand apparently correlative with the main pay. In addition, an oil zone was found in beds thought to be of Carboniferous age.

Drilling and Production To Increase in Brazil

Petrobras expects crude oil production in Brazil to reach 25 million barrels in 1959, an average of 68,493 barrels daily. Output of 18,922,738 barrels in 1958 was an average of 51,843 daily.

For 1959 Petrobras has programmed the drilling of 266 wells, including 149 development wells and 117 wildcat and stratigraphic tests. In 1958 completions totaled 138 wells, including 82 development wells and 56 wildcat and stratigraphic tests.

Late in 1958 a significant new 300 barrels daily oil discovery was reported near Sao Sebastiao in the Bahia area.

Four Rigs to Drill 21 Arabian Wells in 1959

Arabian American Oil Company completed 23 wells in Saudi Arabia during 1958. It expects to complete 21 during 1959. Four rigs are expected to operate during most of this year.

In January, three rigs were operating. The offshore outfiit was temporarily shut down, while the drilling barge, "Queen Mary," was undergoing a routine two-month overhaul at Bombay, India.

World of Oil . . .

Bahamas: Bahamas California-Gulf Cay Sal Bank 1 was coring below 15,600 feet in January, 1959, with 7-inch casing run and cemented at about 15,000 feet.

Barbados: Barbados Gulf Oil Corporation's Morgan Lewis 1 had been drilled to 15,000 feet by early 1959. It was to be deepened if feasible.

Chile: The first oil discovery on the mainland, north of Tierra del Fuego, across the Magellan strait, was reported.

Cuba: From 60 to 70 wells probably will be completed in 1959, compared with 51 in 1958. Crude oil production in 1958 totaled about 358,000 barrels, an average of 980 barrels daily.

Iran. Iran Pan American Oil Company (IPAC) hopes to be ready to start drilling on offshore concessions at the head of the Persian Gulf by mid-year 1959.

Israel: Denver-Golden Oil and Uranium Company acquired rights to drill one and possibly as many as five shallow tests on the Kurnub structure in the Negev.

Somalia: Sinclair Somal Corporation is drilling its fourth wildcat, Mogadico 1. It had reached 4,600 feet by early 1959.

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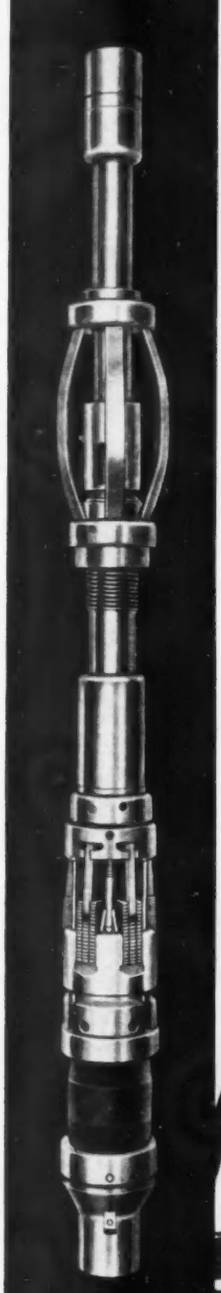

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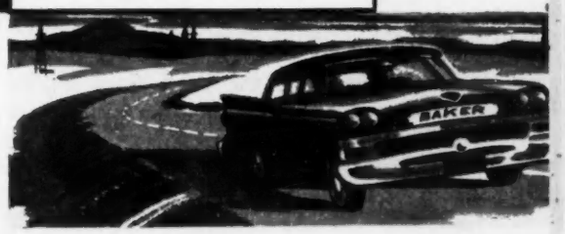

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For Your PRODUCTION File

PART 7

Here's a discussion of . . .

Reservoir study fundamentals

Accurate future predictions are dependent upon quality and quantity of basic data

By Frank W. Cole
Assistant Professor of Petroleum Engineering
University of Oklahoma, Norman

A RESERVOIR STUDY is an investigation of factors governing the behavior of a petroleum reservoir, the end result of which is a recommended operating program which will yield maximum net income from the property. Complete reservoir studies may require months, or even years to complete, depending on the complexity of the reservoir and the thoroughness of the study. It should be emphasized that a thorough reservoir study cannot be completed in a few days or a few weeks. So-called "thumbnail" studies often are made. However, these studies are of value only to indicate trends in reservoir behavior, or to determine the need for a full-scale study.

Stated broadly, a reservoir study is comprised of three basic parts:

1. matching past behavior.

2. predicting future behavior under various possible operating programs (various fluid withdrawal rates, water injection or gas injection).

3. recommending the best over-all operating plan for the reservoir.

The first step in any investigation after the data have been assembled is the matching of past behavior. Referring to Figure 1, the solid lines represent the actual pressure-production and gas-oil ratio history of the reservoir. If a reliable study is to be made, the amount of past production from the reservoir must be substantial. The exact amount of past history which has to be accumulated before a reservoir study can be relied on is difficult to establish due to the many variable factors involved. A rule of thumb which many practicing engineers use is that it is safe to predict ahead the same number of years for which past production history is available. In other words, if a reservoir has been producing for ten years, it should be safe to predict ahead for ten additional years. As more and more data are accumulated the accuracy of reservoir predictions normally will increase.

Starting at the time of initial production from the reservoir, and using the data which have been accumulated, a series of reservoir performance predictions are made. No attention is paid to actual reservoir history. Reservoir performance predictions are made to cover the time from original production to the current date. These data, the "predicted" performance over the past produc-

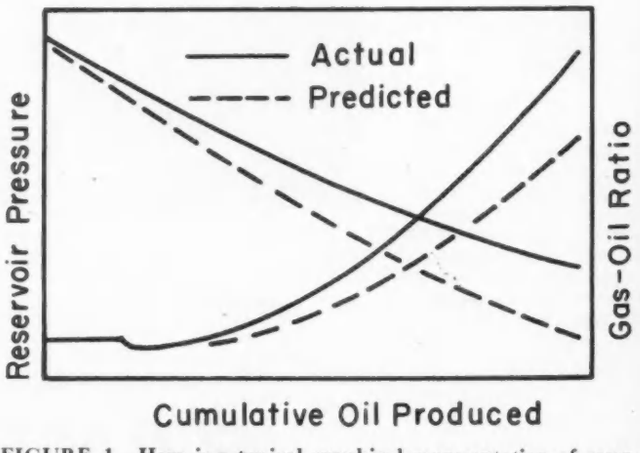
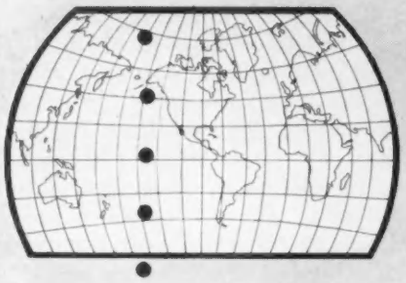


FIGURE 1—Here is a typical graphical representation of reservoir performance. Since actual and predicted behaviors do not match, incorrect equations or false data have been applied. Recognition and correction of all possible errors is essential for accurate results.



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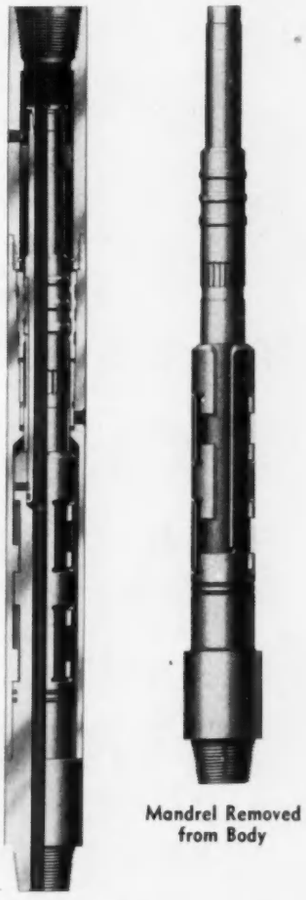

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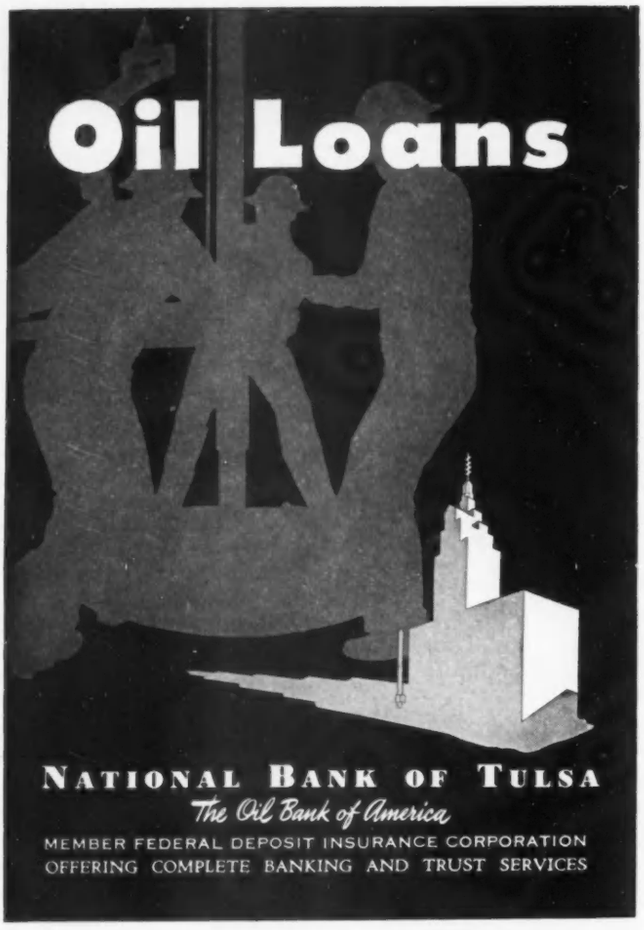
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ing history of the reservoir, then are plotted as in Figure 1, which also shows actual production history. A typical plot is shown by the dotted lines in Figure 1. Here calculated reservoir performance does not match actual reservoir performance. This often is the result after an initial prediction. It can be seen from Figure 1 that if future predictions of reservoir behavior had been initiated immediately, in all probability predicted future behavior would not match actual future behavior. If predicted past behavior does not match actual past behavior, there is no basis for believing future predictions will be accurate.

It now is necessary to determine why predicted and actual past production histories do not match. There are two possible sources of error:

1. incorrect equations

2. Incorrect data

In most cases, proper care has been taken in selecting equations, thus it must be assumed that these equations are correct. The only remaining area of potential misinformation lies in the numbers used in the equations.

The data which are used in the equations may be subdivided as follows:

- Reservoir pressure data
- Reservoir fluid data obtained from either subsurface or recombined samples
- Oil, water, and gas production data
- Geologic data, such as size of the original oil zone, gas cap size and water influx.

If equations used to predict past behavior are correct and an incorrect answer is obtained, it is obvious that incorrect data have been used.

Therefore, the next step in the study is a reevaluation of all reservoir data in order to correct discrepancies. This may be a tedious, time-consuming job, but nevertheless a necessary requirement. A close appraisal of all reservoir data may indicate possible errors in some of the data. In this case a tentative correction in the data is made and past reservoir performance again is "predicted." If this correction fails to yield a perfect match between predicted past behavior, then further study of the data must be made.

In cases where a study of all reservoir data fails to yield a potential source of error, it may be simpler to examine calculated results to determine what factors in the equations would have to be changed in order to yield the desired match. For example, it might be determined that a small change in original reservoir pressure would result in a match between predicted and actual behavior. Then the original reservoir pressure measurement could be examined critically to determine whether or not there would be any justification for the change. Likewise, it might be determined that a small change in reported gas production would yield the desired match, in which case gas production data could be examined very closely to locate possible errors in gas measurement.

Before finally changing any basic data to provide a match between predicted and actual past behavior there should be some justification for the change. Arbitrarily changing original reservoir pressure just because this would achieve the desired match is not good practice. This may temporarily solve the problem, but if the real problem is the omission of gas production, then this may result in a compounding of errors in future work.

(TO BE CONTINUED)

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The petroleum engineer, speaking of trade relations, said there are times when he'd like to.

Modern Girl

"Is she really dumb?"

"Dumb? Why she is so dumb she thinks a football coach has four wheels."

"I'll say she is dumb! How many wheels does it have?"

"Well, its *still* good grazing land."

Well Covered

"Is this the Fidelity Insurance Company?" asked the anxious female voice.

When assured that she had the right number, she continued:

"I want to talk to somebody about getting my husband's fidelity insured."

Spinning Yarns

A widely traveled sportsman, known for his long, involved boring and sometimes incredulous stories, was in the midst of another of his stories.

"And while I was wandering through this deserted village, out in the brush I spotted a leopard."

"That does it," a listener cried. "I always knew he was a liar. Leopards come that way."

Late Arrival

A drunk fell from a two-story window and hit the pavement with a terrific impact. A crowd gathered and as the drunk staggered to his feet someone grabbed him by the arm and asked, "What happened?"

To which the drunk replied, "I dunno; I just got here."

The Big Payoff

"I wonder what's the matter with our star basketball player, he looks so unhappy."

"It's because his father is always writing him for money."

$64 Question

We heard of a guy on a quiz program who defined Alabaster as an illegitimate Mohammedan.

Bride and Groom

The young couple signing the hotel register asked the room clerk for the best accommodations. He recommended the bridal suite.

"Why the bridal suite," asked the young man. "We've been married for five years."

"Well," said the clerk. "If I let you have the grand ballroom that doesn't mean you have to dance."

Lost Footing

Conversation in a London pub:

"How did Bill die?"

"'E fell through some scaffolding."

"Whatever was he doing up there?'

"Being 'anged."

Quick Thinking

Policeman (producing notebook): "What's your name?"

Speeding motorist: "Aloysius Alsaliat Chysianczjiachas."

Policeman (putting away notebook): "Don't let me catch you speeding again."

Rough and Ready

A meek little man walked into a bar, ordered two drinks from the burly bartender, drank one and poured the other into his shirt pocket. After about 10 rounds of this procedure the bartender says, "Pal, why are you pouring the other drink into your shirt pocket?"

The little man jumped up and snarled, "Mind your own business, you big oaf, or I'll come over the counter and whale the daylights out of you."

About that time a blurry-eyed mouse stuck his head out of the man's shirt pocket and said, "Yeah, and that goes for your darned cat, too."

Fury Tale

Chorine admiring another's mink stole asked: "Did you get it from a friend?"

"Well," snapped the other, "you don't get them from strangers."

Great Expectations

Ever hear of the old maid who would have died had the hospital doctors put her in a ward? They were afraid, in her weakened condition, that one bed was all she could look under.

Etiquette

"I won't offer you a drink, Mr. Kane," said the hostess, "since you are head of the Temperance League."

"No, I'm president of the Anti-Vice League." . . .

"Oh! I knew there was something I shouldn't offer you."

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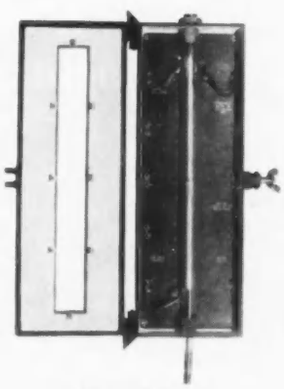

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ANOTHER REASON WHY M-3 BULLET GUNS

DO A BETTER PERFORATING JOB

UNIFORM PENETRATION PATTERN

FIRING ALL SHOTS AT ONE TIME...

McCullough TOOL COMPANY

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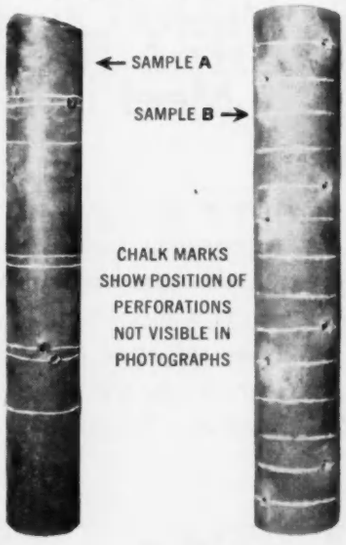
Deep, evenly spaced perforations that *uniformly* cover the productive zone—assure you of the most effective perforating job—and that's what you get when you shoot for production with McCullough M-3 Bullet Guns.

An M-3 Gun fires all shots at one time while the gun is motionless in the casing. Thus, perforations are the exact pattern of the chambers in the gun—in any shot density desired.

Combine McCullough's precise depth measurements with deep, evenly spaced perforations covering the *entire* pay zone and you get maximum drainage from formation to well bore—best possible production.

prevents bunching of shots in one small area in pay zone, giving insufficient coverage—prevents scattering of shots over a wide area, possibly missing the pay zone entirely. Sample A (actual photo of pipe recovered from well) shows the erratic shot pattern produced by a gun firing one shot at a time. As each shot is fired the upward thrust of released gases causes the gun to dance up and down.



eliminates the danger of possible pipe damage or failure. Too many perforations in one spot or in a coupling can cause pipe to part if it is in severe tension. Sample B is an actual example of six shots per foot fired by an M-3 Bullet Gun. Note the uniformity of shot pattern—no danger here of seriously weakening your casing, and you get the most productive perforating job possible.

What's Happening

among MEN in the INDUSTRY

L. J. Whetsell

J. A. Hale

L. J. Whetsell has been appointed to the newly-created position of Division Manager, Southwest Division of the Employe and Public Relations department of **The Texas Company. J. A. Hale** has been named to replace Whetsell as director of Industrial Relations for Texaco's Domestic Producing department.

J. W. Brown has been named field superintendent for the Hobbs producing area of **Pan American Petroleum Corporation.** The Hobbs area office directs Pan Am drilling and producing operations in 40 fields in southeastern New Mexico. Brown is replacing **R. L. Hendrickson** who has retired. In 1948 Brown joined Pan American as a junior petroleum engineer in the Hendrick area office, and has since held engineering and supervisory positions at Midland, Henderson, and Brownfield, in Texas; and at Roswell, N. M., where he has been district engineer since 1955. Brown is a member of the A.I.M.E., and the A.S.M.E.

P. H. Bohart has been designated vice president and coordinator of Crude Oil department for **Gulf Oil Corporation**. A veteran of nearly 40 years with the company, Bohart is responsible for the administration of Crude Oil department worldwide affairs and for coordinating them with other departments concerned. He also is chairman of the company's Crude Oil Council and a representative on the company's Administrative Committee.

P. H. Bohart

Victor H. King has been elected director of exploration, **General Petroleum Corporation,** succeeding **Carroll M. Wagner,** who retired after 40 years of service. King, who has been manager of exploration since 1954, joined General Petroleum in 1936. His first position was as a well puller in the production department in Kern County. Since that time he served as a rotary helper and gager in the production department, and in 1937 became an assistant petroleum engineer in the geological department with headquarters in Los Angeles. In the geological department he has held the positions of petroleum engineer, assistant geologist at Coalinga, geologist at Sacramento, senior geologist at Casper, Wyo., and in 1948 became supervisor of exploration in the Rocky Mountain District with headquarters at Casper.

Victor H. King

The **Petroleum Club of Los Angeles** recently held its annual meeting of the board of directors and the following officers were elected: **Dudley Tower,** vice president of **Union Oil Company,** was elected president; **Earl Hightower,** partner in the law firm of **Hightower, Gregg and Garland,** was elected vice president; **Gordon Campbell,** assistant comptroller of **General Petroleum Corporation,** treasurer, and **Richard Sneddon,** club manager,

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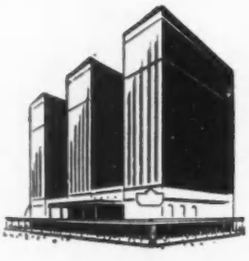

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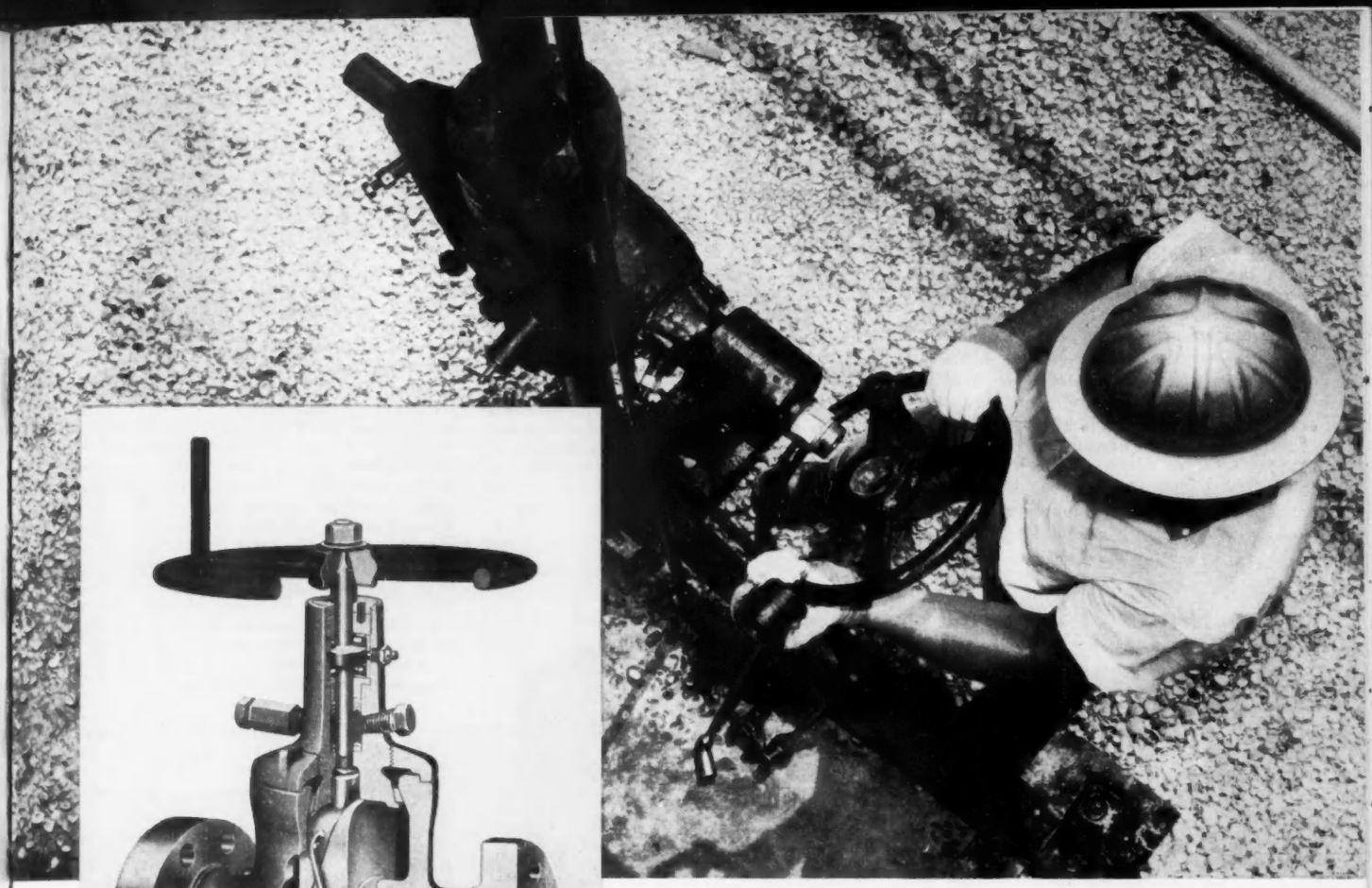

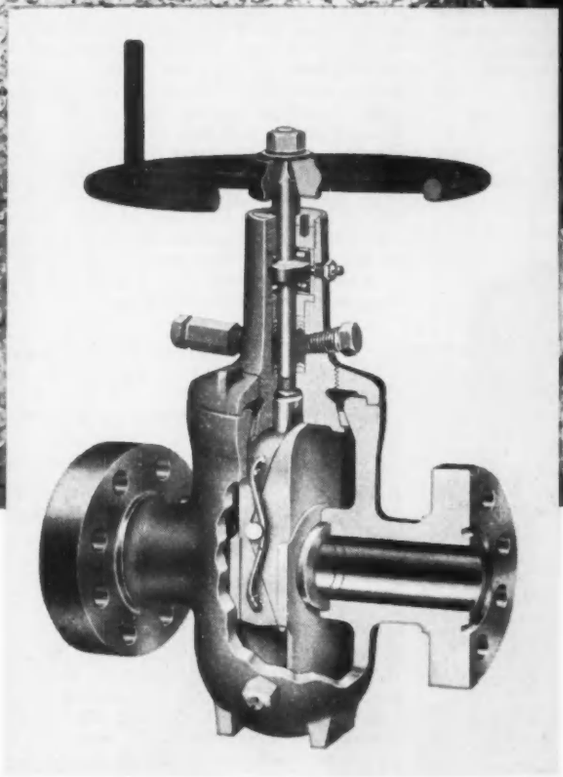

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HALLIBURTON PRODUCTION PACKERS

elected secretary. Also, three new directors were elected for a three-year term. They are **Fred B. Behrens,** assistant to the vice president, **Richfield Oil Corporation; R. A. Keans,** president, **Keans, Springman & Stipek** and **E. (Pick) McIver,** consultant, formerly of Shell Oil Company.

Ralph S. Fowler has become associated with the **Pure Oil Company.** Fowler will be in charge of the sale and acquisition of foreign crude oil for the company. His headquarters will be in New York City. Fowler served with Aramco Overseas Company a subsidiary of the Arabian American Oil Company, and most recently has been associated with the Department of the Interior in Washington, D.C.

William R. Yinger

Jack E. Trigg

King-Stevenson Oil Company, Chicago oil and gas exploration and development firm, has announced the appointment of three new executives, and the opening of a new divisional office in Denver, as initial steps in a major expansion program. First appointment was that of **William R. Yinger,** formerly southwestern division manager, to the post of general exploration manager with headquarters in Oklahoma City Yinger will supervise all exploration, production and land department activities for the company. **Jack E. Trigg,** formerly vice president of Trigg Drilling Company, has been appointed manager of the company's Rocky Mountain-Williston Basin division, with headquarters in the newly-created Denver office. **J. Keith Miller,** for the past six years with the land department of the Pan American Petroleum Corporation, has been appointed manager of the land department for all divisions of King-Stevenson. From headquarters in Oklahoma City, he will handle lease purchasing, clearing of titles, and negotiations with other oil companies on farmouts and acreage trades.

J. Keith Miller

E. J. Theessen, former division stratigrapher for **Shell Oil Company,** San Antonio, has retired from Shell and has opened an office as consulting paleontologist in San Antonio.

Alvin R. Martin has been appointed head of the Law department of **Gulf Eastern** and **Gulf European Companies,** eastern hemisphere subsidiaries of **Gulf Oil Corporation.** He will headquarter in Gulf House, London.

J. Bruce Gafill, Jr., South Bend, Ind., and **R. W. McDowell,** president of D-X Sunray, Tulsa, have jointly announced the acquisition of the **Gafill Oil Co.** by **D-X Sunray Oil Company.** The company was to be renamed the **Gafill D-X Oil Company** and will operate as a D-X subsidiary marketing D-X products from South Bend headquarters in a 16 county area of North Central Indiana and Southwest Michigan.

Paul W. McFarland, of Sun Oil Company, has been appointed manager of the company's Latin America production division. The division is currently carrying on exploration and production activities in Venezuela, Colombia, Guatemala, Cuba and the Bahamas. McFarland succeeds the late **Benton E. Warren. Lee C. Smith** replaces McFarland as exploration manager for the division.

P. W. McFarland

Forrest S. Elleman has been appointed manager of **The Pure Oil Company's** general engineering department, succeeding **W. Dean Kinsell** who will serve as an engineering consultant and take active charge of Pure's suburban office building project. Elleman joined Pure in 1947 as an electrical engineer. Since then he has served in various engineering executive capacities. He was named assistant to Kinsell in April, 1958.

You'll win more than this prize. You'll increase drilling efficiency and control your mud better. Mud-O-Graf records every variation in mud weight, saving time and costly errors in the addition of weighting materials. All heavy and light streaks in the circulating system and their duration are recorded. Mud-O-Graf shows how often the hole is filled up when coming out of the hole and shows the time of a complete circulation. If it's a question of mud, ask for Mud-O-Graf.

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Phillips chose two Halliburton Type "C" Production Packers for the unique job of successfully isolating, treating and testing a zone from 24,897 ft. to a T. D. of 25,340 ft. in the world's deepest hole.

Halliburton Special Tools Operators running Type "C" Production Packers for the world's deepest test in Phillips Petroleum Company's No. 1-EE University Well, Pecos County, Texas.

This unusual testing and treating technique applied in the world's deepest hole was planned and supervised by Phillips personnel who collectively reviewed hole conditions and expected good performance of the Halliburton Production Packers before packers were run in hole...

The first packer was run and set in 13 hours and 60 seconds. Rate of descent was 30 seconds per 90 ft. stand, in 7⅝ and 7 inch casing to top of liner at 22,682 ft; then 75 seconds to 90 seconds in 5″ liner to desired depth.

The second packer was set six feet above first packer. Both packers easily set in normal manner—pipe was rotated to set upper slips; an upward pull on drill pipe expanded packer, set lower slips and sheared tension sleeve freeing drill pipe and double seal units from packer before job began.

The packers were subjected to extremely rigorous conditions through loading and circulating drill pipe to surface, swabbing jobs, pressure testing many times to 10,000 psi and pumping into formation and treating bottom zone near 10,000 psi. Packers were unaffected by bottom hole temperatures of 320°F.

More than 37 Halliburton Production Packers have been successfully used for this purpose in 3 wells in the Pecos County Area alone!

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Harold Burrow

Charles W. Hamilton

Tennessee Gas Transmission has announced that three Houstonians were recently named to the company's board of directors while a fourth resigned as director and became the firm's first director-emeritus. The new directors are: **Harold Burrow**, executive vice president of the company; **Charles W. Hamilton**, senior vice president and trust officer of the **National Bank of Commerce**, and **H. Malcolm Lovett**, senior member of the law firm of **Baker, Botts, Andrews and Shepherd.** The new director-emeritus is **A. Dee Simpson**, honorary chairman of the **National Bank of Commerce.**

H. Malcom Lovett

The Victoria Bank and Trust Company, Victoria, Texas, recently elected two new directors at its annual stockholders meeting. **P. K. Stubblefield,** senior vice president of the bank and **Ben F. Vaughan, Jr.,** Corpus Christi oil man and attorney, were elected to the board. All other directors were re-elected, raising the board members to 21.

Robert C. Read has been elected president of **The Gordon Co., Inc.,** Norwalk, Conn. Read was formerly vice president of Skiles Oil Corporation, Mt. Carmel, Illinois. Prior to 1940, he was assistant to the director, Domestic Operations, in the administrative offices of Socony Mobil Oil. Read will be chief executive officer of The Gordon Company and, as such, will head the planned expansion of their Petroleum and Mining Exploration division program, here and abroad.

Gardiner Blackman has been appointed manager of the Employe Relations department of **Tidewater Oil Company.** Blackman previously was employe relations supervisor of the company's western division. He succeeds **Howard G. Fillhower,** who resigned. Blackman joined Tidewater in 1926 as a clerk in the Pipe Line department at Watson, Calif., and then progressed through the western division Employe Relations department, becoming supervisor in 1944.

Gardiner Blackman

Joe L. Stanton

Joe L. Stanton has announced the formation of the **Stanton Oil Company, Ltd.** Limited partners and major investors in the new firm include **David G. Baird** and **Mark J. Millard** of New York, and **Peerless Oil and Gas Company** of San Antonio. **Vernon F. Taylor** is president of Peerless. Stanton is former vice chairman and treasurer of the Slick Secondary Recovery Corporation of which he was an organizer. Offices for the company are in the National Bank Building in San Antonio.

C. J. Colby is the manager of the New York City office recently opened by the **Kerr-McGee Oil Industries, Inc.** Colby will coordinate activities of the company in the New York area. A substantial portion of his time will be devoted to foreign drilling contracts and other related phases of the company's operations.

Frederick E. Merliss has been appointed manager of the **Cities Service Production** and **exploration research laboratory,** Tulsa, Okla., and **Bernard H. Rosen** has been named manager of the **Cities Service Product Development Laboratory** at Cranbury, N. J. Merliss joined the Cities Service organization in August, 1953, as research engineer, and has served as Assistant Manager of the Tulsa Laboratory from January, 1 1957, until the present time.

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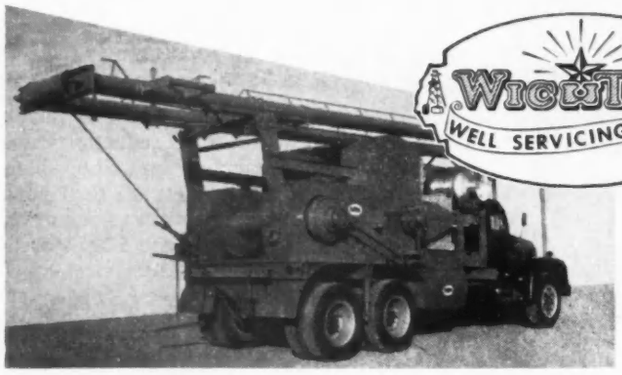

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D. K. Dressback, Oklahoma City, former comptroller for **Tekoil Corporation,** Dallas, has been elected treasurer of the company. He will continue to make his headquarters in Oklahoma City.

Continental Oil Company has announced the promotion of three men to key positions in the company's central region land department. The men are: **W. B. Beall,** Oklahoma City, division land superintendent, promoted to assistant central region land superintendent. He will continue to make his headquarters in Oklahoma City. **T. E. Wells,** Fort Worth, general landman, promoted to division land superintendent at Oklahoma City, succeeding Beall. **W. W. Blair,** Ardmore, Okla., assistant division land superintendent. He will continue to have his headquarters at Ardmore and will succeed **H. M. Dawson** who recently was promoted to assistant land superintendent for Conoco's southwestern region, with headquarters in Fort Worth.

Delhi-Taylor Oil Corporation of Dallas is moving its Farmington, N. M. district exploration office to Denver to give the company a central base of operations for a stepped-up oil and gas exploration program in the Rocky Mountain area. The exploration moves involves **Zachary B. Jones,** district landman and **C. W. Robinson,** subsurface geologist. The Company's district production office, headed by Superintendent **J. B. Howell,** will remain in Farmington. The company's district mineral exploration office will remain at Moab, Utah, where **Robert R. Norman** is exploration supervisor there.

H. D. Hobson has been named manager of exploration, **General Petroleum Corporation.** Hobson succeeds as head of General Petroleum's exploration activities **Victor H. King,** who becomes exploration manager of **Mobil International Oil Company,** newly formed operating division of **Socony Mobil Oil Company Inc.** Hobson joined General Petroleum in 1940 as a geologist in the company's Bakersfield, Calif., office. Since that time he has held the positions of division geologist, exploration supervisor and assistant manager of exploration.

H. D. Hobson

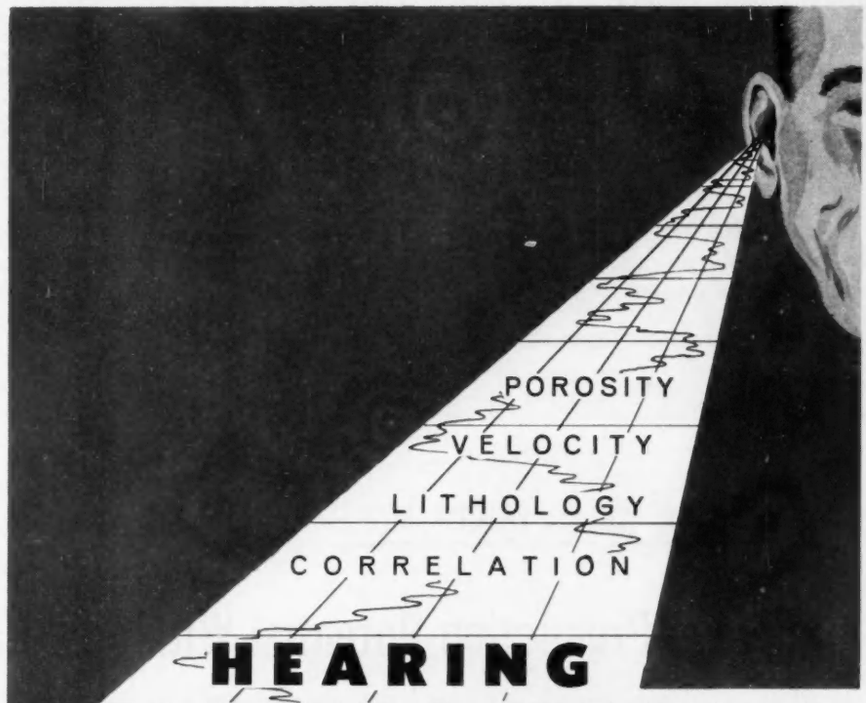
W. V. Criddle has been named manager of traffic and **V. W. Frederickson** has been named manager of employment for the **Union Oil Company.** Criddle replaces **L. V. Monroe** and Frederickson replaces **John Rockfellow.** Both Monroe and Rockfellow have retired.

Continental Oil Company has announced the promotion of three men to key positions in that company's southern region land department. **John W. McReynolds,** Houston, assistant regional land superintendent has been promoted to division land superintendent at Corpus Christi, succeeding the late **T. D. Craft. James Wilkerson,** Houston, division land superintendent, has been promoted to assistant to the regional land superintendent at Houston, replacing McReynolds. **H. L. Dubuisson,** New Orleans, assistant division land superintendent, has been promoted to Houston division land superintendent succeeding Wilkerson.

George E. Cameron has been appointed vice president in charge of finance for the **Brown Drilling** and affiliated companies, Long Beach, Calif. Cameron will handle much of the liaison between Brown's far-flung foreign operations and the home office in Long Beach. Contracts and other arrangements with foreign governments and private groups will be included in his new duties.

Beaver Lodge Oil Corporation has announced major changes in the management of that firm. **William H. Hudson** of Dallas and New York, independent oil operator and investor, was elected president and chairman of the board. **Joseph B. Avant,** independent geologist, Dallas, was named vice president and **B. G. Fuller** was elected secretary-treasurer. **Stuart Bennett** has been appointed general manager of company operations. New directors of Beaver Lodge are **Hudson, Eugene V. Klein** and **Burt Kleiner** of Beverly Hills, Calif., **Thomas R. Hartnett, III,** Dallas attorney and **Lee Van Atta** also of Dallas. **Merle Thrope,** former president of the company, remains a director.

Socony Mobil Oil Company, Inc., has announced the appointment of **Wilfred M. Kluss** as assistant to the general manager of the marine transportation department. Prior to assuming his new position, Kluss served as senior area executive in the department of Middle Eastern affairs.



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High in the Rocky Mountains, oil and gas producers are turning more and more to Dowell for acid-base fracturing services. Both limestone and dolomitic formations of this area respond well to Acid Petrofrac.

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Most formations—even many sandstones—contain important amounts of acid-soluble calcareous materials. Often, the results of fracturing such formations are improved when an acid-base frac fluid is used.

The reasons for these improved results vary with formation characteristics and the particular fluid used. In general, however, it is believed that fractures are deepened and enlarged. Furthermore, the porosity and permeability of the formation next to the fractures is increased, so well fluids can flow more readily into the fractures.

In many cases, the result is a reduction in the pressure loss between the formation and the well bore, as indicated by an improved productivity index. Often, after fracturing with one of Dowell's acid base fluids, a well that had been on pump will flow for a considerable time.

Dowell can tailor acid-base fracturing fluids to the requirements of nearly any well and treating procedure. Fluids can range from water-thin to extremely viscous. Sand-falling rate can be controlled over wide limits. Acid concentrations can range from less than one per cent to above 20 per cent. Any of several Dowell Fluid Loss Additives (F.L.A.*) may be used depending on the nature of the fluid and other requirements.

Reaction time of the acid can also be varied within wide limits. Most Dowell acid-frac fluids have a retarded action, but some are actually "intensified" to speed reaction.

On the opposite page you will find some of the problems frequently encountered for which Dowell provides proved solutions.

In addition to a complete set of fracturing services, Dowell offers you full research facilities and equipment second to none in the oil fields. These are good reasons why it makes sense to call Dowell for your next fracturing treatment.

For prompt service, or detailed information call your nearest Dowell representative. There are more than 165 locations to serve you in the U. S. In Canada, contact Dowell of Canada, Ltd.; in Venezuela, United Oilwell Service. Dowell, Tulsa 1, Oklahoma.

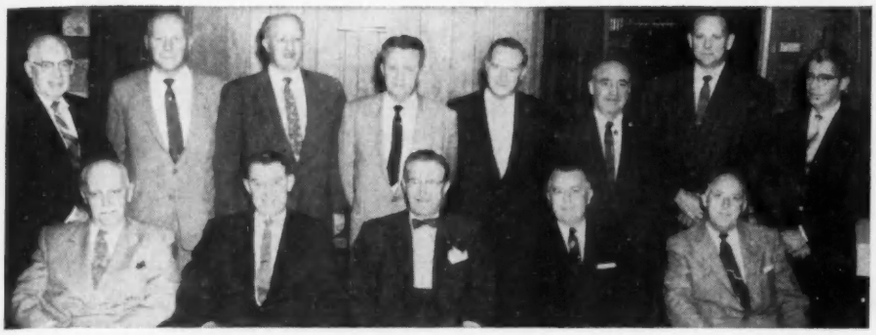
Services for the oil industry

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

what's Happening

among INDUSTRY ASSOCIATIONS



Los Angeles NOMADS Elect 1959 Officers

Officers of the Los Angeles Chapter of NOMADS for 1959 were elected recently at the annual business meeting. Shown are the outgoing and incoming officers: from left to right (back row) Leo Cypher of Baash-Ross Tool Company, secretary 1959; Andy Anderson of Pacific Perforating Company, sergeant-at-arms 1959 (deputy sergeant-at-arms 1958); C. F. Van Loozen of Power Rig & Equipment Company, (treasurer 1958); Taylor Bannerman of Technical Oil Tool Corporation, vice president 1959 (assistant treasurer 1958); Charles M. King of Baker Oil Tools, Inc., assistant secretary 1959; P. M. (Shorty) Bowen of Martin-Decker Corporation, assistant treasurer 1959 (Assistant Secretary 1958); Arthur S. Marshall of H. C. Smith Oil Tool Company, deputy sergeant-at-arms 1959; Knight Templeton of S. R. Bowen Company, Treasurer 1959 (Secretary 1958); (front row) Earl R. Atkins of Devex Engineering Company (vice president 1958); Robert P. Gaylord of Wagner-Morehouse, Inc., senior regent 1959 (junior regent 1958); Earl M. Daniels of Hydril Company, junior regent 1959 (president 1958); Tom Ashe of Globe Oil Tools Company, president 1959 (sergeant-at-arms 1958); Harry Hester of McCullough Tool Company, (senior regent 1958).

Weeks to Assume AAPG Reins at Dallas Meeting

Lewis G. Weeks, consulting geologist of Westport, Conn., has been elected president of the American Association of Petroleum Geologists.

Harold T. Morley, chief geologist, Pan American Petroleum Corporation, Tulsa, was re-elected secretary-treasurer while Alfred H. Bell, Illinois State Geological Survey, Urbana, Ill., was elected vice president and Grover E. Murray, Louisiana State University, was named editor.

The officers will be installed on the last day of the organization's Forty-Fourth Annual Meeting in Dallas, March 16-19.

Abilene Geological Society Elects 1959 Officers

The Abilene Geological Society, Abilene, Texas, recently elected new officers for 1959. Those elected were: Richard R. Bloomer, independent, president; Dorman N. Farmer, Wayne Petroleum Company, vice president; Eugene M. Peeples, III, Humble Oil & Refining Company, secretary; Richard R. Church, Magnolia Petroleum Company, treasurer.

Desk and Derrick President Names Committee Chairmen

Chairmen of standing and special committees of the Association of Desk and Derrick Clubs of North America for 1959 have been announced by Association President, Miss Ellen M. Vaughan, The Carter Oil Company, Shreveport.

Standing Committees: Public Relations, Miss Helen Little, The Carter Oil Company, Oklahoma City; Program, Miss Doris L. Hege, The Ohio Oil Company, Washington, D. C.; Finance and Budget, Mrs. Fae Matson, Treasurer, Gulf Oil Corp., Odessa, Texas; Statistical, Miss Nell Hagaman, Shell Oil Company, New York; Membership, Miss Virginia Auer, American Petrofina Co. of Texas, Dallas; Rules, Mrs. Zetta Belle Gregg, Independent Oil Producers' Agency, Los Angeles.

Special Committees: Convention—Mrs. Julia Simpson, Skinner Corp. and Mrs. Doris Post, Rinehart Oil News, chairman and co-chairman, respectively, both of San Antonio; Handbook—Mrs. Lois Giltner, Cit-Con Oil Corp., Lake Charles, La.

Editor, The Oil and Gas Journal, Miss Gladys Watford, c/o Ralph A. Johnston, Houston; Editor of Scrapbook, Miss Jerry Benge, Texas Gas Transmission Co., Houston.

NACE Will Install New Officers at Conference

New officers of the National Association of Corrosion Engineers elected to serve for the 1959-1960 term, will be installed at the association's Fifteenth Annual Conference that will be held in Chicago, March 20. In addition to the new officers, three men elected to the board of directors also will take office for three year terms.

Taking over as new officers for the association are Hugh P. Godard, Aluminum Laboratories, Ltd., Kingston, Ont., president; George E. Best, Solvay Process Division, Allied Chemical Corporation, vice president and A. L. Stegner, Tennessee Gas Transmission Company, treasurer.

Elected to directorships were: J. P. Barrett, Pan American Petroleum Corporation, and E. L. Simons, General Electric Company, Research Laboratory, both to represent active members on the board, and Guy F. Williams, Dowell Incorporated, to represent corporate members.

Sustained interest in corrosion control the world over is expected to attract more than 1600 engineers to the conference. The conference will be held March 16-20 at Chicago's Hotel Sherman. The 1959 Corrosion Show will be held concurrently, March 17-19 at the hotel.

W. T. Crowder Chairman Of East Texas AIME

W. T. Crowder, district manager of the East Texas area of Lufkin Foundry and Machine Company, Lufkin, Texas, has been elected chairman of the East Texas Section of Society of Petroleum Engineers of A.I.M.E.

W. T. Crowder

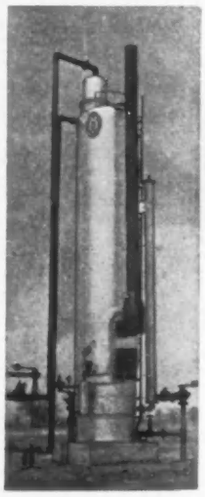
The East Texas Section is composed of some 400 members, and covers an area from Oklahoma south to Angelina County, and from Dallas east to the Louisiana border. Crowder is a past vice-chairman and program chairman of the East Texas Section. He has been with Lufkin Foundry for 13 years.

Other new officers of the East Texas Section of the Society of Petroleum Engineers include Hugh Barton, Humble Oil & Refining Company, Tyler, vice-chairman, and J. J. Bresenham, Magnolia Petroleum Company, Kilgore, program chairman.

New Officers of Southwest Texas AIME Elected

The Southwest Texas Section, Society of Petroleum Engineers of AIME held an election of officers for 1959 recently and the following (standing left to right) were elected: Bob Miner, first vice chairman, Spartan Well Service; J. J. Lawnick, secretary-treasurer, American Petrofina Company of Texas; Todd Storer, past chairman, Pan American Petroleum Corporation; Joe Bielstein, chairman, Humble Oil & Refining Company, and W. B. Phillips, second vice chairman, Union Producing Company.

For
OPERATING ECONOMY



MFD BY M&V TANK COMPANY WICHITA FALLS TEXAS

Type P-V Pressure Treaters

M & V TANK COMPANY
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TANKS – TREATERS
SEPARATORS
Steel Fabrication for the Oil Industry

for leakproof, pressure-tight connections
use TiteSeal®
SEALING COMPOUNDS
Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

7 BASIC BLENDS

LIQUID WRENCH®
The super-penetrating rust solvent

LOOSENS
rusted bolts, nuts, screws, 'frozen' parts
Liquid Wrench works *fast*...yet is absolutely safe for all metals and alloys.

2171

At Industrial, Automotive, Hardware, Plumbing Jobbers
RADIATOR SPECIALTY CO.
Charlotte, North Carolina
SOLDER SEAL

What's Happening among SERVICE and SUPPLY MEN

G. K. Harcourt

J. W. Lyon

Recent promotion of three men to the newly created post of assistant to the vice president of sales has been announced in Fort Worth by **Welex, Inc.** New assistants to the vice president of sales in Houston are **G. K. Harcourt,** former special salesman at Tulsa, and **J. W. Lyon,** former division sales manager at Houston. Promoted to the same position in Tulsa was **R. B. Burns,** former Tulsa division sales manager. Harcourt has 10 years experience in oil well service work and has been with Welex for one year. Lyon has been with Welex since December, 1955, and has 22 years experience in oil well service work. Burns has been with Welex for the past nine years. All three men are members of American Petroleum Institute and AIME.

R. B. Burns

The appointment of **Ray T. Rigney** as field service manager has been announced by **Lee C. Moore Corporation** of Tulsa. Assistant plant superintendent for 8 years, Rigney will now direct all field service operations and personnel. He will work closely with customers on programs of maintenance and maximum safety related to the erection and use of Lee C. Moore equipment throughout the world. He will also make periodic inspection tours to find ways of increasing the efficiency of maintenance and service.

Ray T. Rigney

United States Steel Corporation has announced the following new appointments and transfers. **William J. Miller** has been appointed **U. S. Steel Oil Well Supply Division** field representative at Fort St. John, B. C., Canada, and **William H. Combs** was appointed field representative at Casper, Wyo., **Joe E. Michie,** field representative for U.S. Steel's Oil Well Supply Division has been transferred to Abilene from Sweetwater, Texas, and **Wilburn D. Lakey,** field representative at Houston has been transferred to Brookhaven, Miss.

William O. Blandford has been named assistant to the merchandising manager of **The Dayton Rubber Company's** Mechanical Goods division. He will handle new product development and promotion under the direction of **L. J. Adams,** merchandising manager. Prior to joining Dayton Rubber, Blandford was an account executive for Haig and Patterson, Inc., and the Jam Handy organization.

Garrett Oil Tools, Inc., a division of **U. S. Industries, Inc.,** has announced the appointment of two new agents to handle the sale of Garrett Relief Valves, diaphragm control valves, and industrial and pipeline equipment. **James S. Kone & Company,** Amarillo, Texas, will handle this Garrett equipment in the Texas Panhandle, Oklahoma Panhandle and Southwestern Kansas. **Hare Equipment Company,** Cincinnati, Ohio, is the new agent for Western Ohio, Southern Indiana, and Central Kentucky.

V. C. Horner, formerly vice president and sales manager for **Byron Jackson Tools, Inc.,** has been appointed vice president and general manager of BJ Electronics, Santa Ana, Calif. Horner has been associated with Byron Jackson since 1941. After 7 years in oil tool engineering he became assistant chief engineer operating in the Mid-Continent region. In 1951 he assumed general managership of the company's Dempsey Pump Division in Tulsa. Horner returned to Los Angeles to become assistant general manager of Byron Jackson Tools, Inc., in 1955 and was subsequently named vice president and sales manager.

V. C. Horner

Jared S. Smith has been named manager of **Standard Mobile Design Engineering** for **G-E** Communication Products department with responsibility for design activities on new G-E two-way radios. Other G-E mobile radio appointments newly-announced are **Richard T. Buesing,** manager of electronic design; **A. G. Manke,** circuit design engineer; **G. M. Dewire,** standard systems engineer; **J. P. Coon,** mechanical standard engineer; **F. D. Hannell,** product production engineer; **K. K. Bay,** transmitter design engineer, and **A. E. Englund,** power devices design engineer.

Oliver E. Trechter, Jr., has been appointed assistant district engineer at Jackson, Miss., for U.S. Steel's Oil Well Supply Division. Trechter was employed by "Oilwell" in

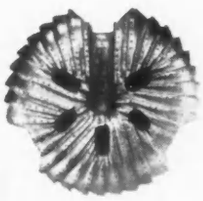
HYCALOG V-DOOR

DIAMOND DRILL BITS

Patent applied for

HYCALOG

ONE BIT DRILLS 1206 FEET IN 15,000 FOOT HOLE



In a South Louisiana well, recently completed, a single $5\frac{15}{16}$" Hycalog V-Door diamond drill bit made the run through sand and shale from 14,324 feet to 15,530 feet. No trips out of the hole were necessary for bit changes and the run was completed in 247 hours at an average drilling rate of 4.8 feet per hour.

When pulled, after reaching the total depth, the bit was found to be in excellent condition and *capable of making a lot more hole.*

This is just one of a number of such records set by Hycalog V-Door bits. Why not let V-Doors set a record on your next drilling program? *And ask us also about Hycalog* Gas Chronofrac *well logging services.*

Hycalog, Inc.

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SHREVEPORT, LOUISIANA

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DIAMOND BITS DIAMOND CORING
WELL LOGGING CORE ANALYSIS

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New York City will be host to this great international event which will be attended by thousands of the world's leading oil men from over 45 countries.

Packed With Important Benefits for You!

At the 5th World Petroleum Congress Exposition, there will be more than 275 fact-filled exhibits demonstrating the newest equipment, techniques, services and materials that have been recently developed for use in the petroleum and petrochemical industries.

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Plan now to attend . . . and bring your key men with you. Their visit will stimulate fresh thinking and new approaches to many problems—just one idea picked up here will make their trip more than worthwhile.

For advance registration and hotel information write the Exposition at 480 Lexington Avenue, New York 17, N. Y. 1240

5th

WORLD PETROLEUM CONGRESS EXPOSITION

New York Coliseum
June 1-5, 1959

Management: International Exposition Co.

1955 as assistant district engineer at Los Angeles, Calif. Later that year he was appointed district representative at Long Beach, Calif., and transferred to Los Angeles in 1957. He was located in the latter city prior to his present appointment. He received a degree in mechanical engineering from Rensselaer Polytechnic Institute.

John F. Reed and **Arland R. Walkley** have been named vice presidents of **Manning, Maxwell & Moore, Inc.** Reed, who is general manager of the Consolidated Ashcroft Hancock Division, joined the company in 1944 as a planning engineer. In 1946, he was appointed works manager of the Division's Tulsa, Oklahoma, plant and, in 1951, was named works manager of the Muskegon, Michigan, plant of the Shaw-Box Crane & Hoist Division. He has been general manager of the C. A. H. Division since 1957. Walkley has spent his entire business career with Manning, Maxwell & Moore, Inc. Currently general manager of the Shaw-Box Crane & Hoist Division, he joined the company in 1941 as an engineering draftsman. He has been, successively, manager of industrial marketing, assistant to the general manager, general sales manager, and general manager of the Shaw-Box Crane & Hoist Division.

Logan T. Johnson, executive vice president of **Armco Steel Corporation,** has been elected a member of the company's board of directors. Johnston was elected executive vice president of Armco earlier last year.

Cardwell Manufacturing Company has announced the appointment of **Don Rhoads** as special sales representative for Kansas and key oil centers in Oklahoma. Well-versed in the oil business, with a machinery and supply background that covers a 24-year period, Rhoads will concentrate on Cardwell's drilling and servicing equipment, mud pump, pipe and supply accounts in that area. He will headquarter at the company's main office in Wichita, Kan., and be available for contact in Tulsa, Oklahoma City, Bartlesville, Ponca City and Great Bend.

Don Rhoads

Houston Oil Field Material Company, Houston, has announced these recent changes and promotions among their personnel. **L. W. Albert** has been transferred from Houston to Beaumont; **W. S. Baker,** from Kimball, Nebraska to Billings, Montana; **R. J. Bradshaw,** from Houston to Odessa, Texas; **Glen Harbert,** from Corpus Christi to sales and service engineer, Houston; **John Kennedy,** from Venice, La., to Hobbs, N. M.; **E. K. Konnerup,** from Casper, Wyo., to Kimball, Neb.; **L. D. McQuaid** from Corpus Christi to Houston; **E. S. Mason,** from Hobbs to Pampa, Texas; **John R. Parker,** from Midland, Texas to Houston; **David Peters,** from Odessa to Houston; **R. M. Smith,** from Houston to Beaumont; **J. W. Strickland,** from Billings to Casper, Wyo., and **Wm. A. Westbrook,** from Carrizo Springs to Freer, Texas.

W. R. Layne

J. A. Beaird

Jones and Laughlin Supply Division has announced a number of major changes of sales personnel and sales districts within that company. **W. R. Layne** has been appointed district sales manager for the Southern Oklahoma district; **J. A. Beaird,** appointed district sales manager of the Western Kansas district and **R. L. Daniel,** district manager for the New Mexico district. **W. J. Whatley** has been appointed city sales manager of the Oklahoma City office; **M. G. Burgeis,** formerly salesman at Hobbs, N.M., has been appointed regional salesman, Drilling Equipment, Midland, Texas, and **A. E. Penrose,** promoted to regional salesman, Production Equipment, Rocky Mountain district, Denver; **E. L. Jackson** has been assigned as salesman-supervisor at the Mt. Pleasant, Mich., store and **F. R. Dewitt** has been assigned store manager, Tulsa.

R. L. Daniel

Write for this NOW!

"How to use three-phase motors on SINGLE-PHASE CURRENT"

. . . and profit from the added economy and efficiency!

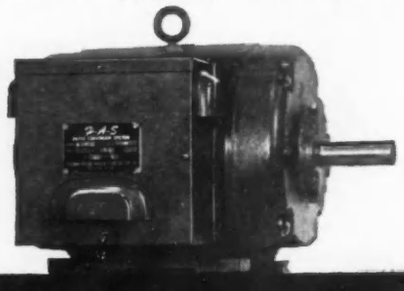
Three-phase motors cost less than single-phase motors, are more efficient, and have far greater salvage value.

The NEW H-A-S Phase Conversion System enables you to use three-phase motors (3 h. p. or larger) on 220 V single-phase current. Three-phase motors cost less, operate for less, and can be used later on three-phase current.

On many rural single-phase lines service is limited to 5 h. p. single-phase motors, but the H-A-S Phase Conversion System permits the use of three-phase motors up to 75 h. p.

The H-A-S is available in two models, for motor mounting and remote mounting.

This is GOOD NEWS in the oil country. To solve an immediate problem —or for your files—write NOW for complete details and the name of your nearest supply store or distributor!



KEN ELLIOTT MOTORS, INC.
P. O. Box 5158-B
BOSSIER CITY, LOUISIANA

H-A-S PHASE CONVERSION SYSTEM

Z. C. Ambrose of Houston has joined **Houston Oil Field Material Co., Inc.,** as executive vice president, it has been announced. Since 1954 Ambrose had been with Associated Oil & Gas Co., and was president of that company for the past year. He was also president of Prince Marine Drilling and Exploration Co. Before going with Associated, Ambrose was vice president and manager of Southwest Gas Producing Company and Carbons Consolidated, Inc., and president of Monla Gas Company, all of Monroe, La. He was also a director of these companies as well as their parent company, Commonwealth Gas Corporation of New York City.

Z. C. Ambrose

Rex C. Clementson has been named district manager of **Findley Engineering Service Co.'s** newly opened Victoria, Texas, office. He will direct operations of the firm's petroleum engineering work in the Victoria area.

Rodman Supply Company, Odessa, Texas, has been appointed as a distributor for **Jones & Laughlin Steel Corporation's** oil country tubular products.

J. Doyle Bain has become a salesman for **Atlas Pipe, Inc.** working out of the Corpus Christi plant. Bain is well known in oilfield supply circles in South Texas, having been with Wilson Supply Co. for five years and with W. C. Norris Mfg. Co. for six years. He is a member of API and AIME.

Lars H. Nordenson

J. Doyle Bain

Lars H. Nordenson was recently appointed vice president in charge of foreign operations for the **Dresser Industries.** Nordenson has previously been affiliated with Liljeholmens Stearinfabriks AB in Stockholm, Sweden, where he was assistant to the president; M. W. Kellogg Co., as sales manager in the London and Paris offices; American Cyanamid Co., New York and Union Oil Company of California. With the latter two firms, Nordenson was an engineering executive.

Robert White has been appointed manager of alloy steel sales for **Sheffield Division, Armco Steel Corporation.** White has been special representative for alloy sales for Sheffield in Houston since April, 1957. White will remain in Houston, where Sheffield Division has recently completed at its Ship Channel mill extensive facilities for producing heat-treated, high-strength alloy steel used in the manufacture of oil and aircraft industry equipment.

Lester G. Evans has been promoted to vice president in charge of sales for the **Axelson Division of U. S. Industries, Inc.,** Los Angeles. Evans has been associated with the company since November of 1957 as general sales manager. Prior to his coming to Axelson, he was vice president and general manager of the All-Power Manufacturing Company, Montebello, Calif.

Lester G. Evans

The promotion of **Beryl Robertson** to the Two-Zone Pump Department of the **Axelson Division** of **U. S. Industries, Inc.,** has been announced. Robertson will assist **Forrest Goin,** who has been active as Axelson Two-Zone specialist for some time. Both men will specialize in the recommendation, application, and installation of Axelson Two-Zone equipment being run in the West Texas-New Mexico area. Robertson has served as Axelson factory representative of subsurface pump and sucker rods in the area for the past three years.

Corrosion Rectifying Company of Houston announces the appointment of **Robert L. Adair** as manager of sales of the supply division with offices in Houston. Adair attended the University of Houston and was at one time owner of the Adair Wireline

New Jensen Rotary Jack offers:

FAST, EASY INSTALLATION

This new Jensen Rotary Jack features floor-clearing cranks and weights, permits installation on flat concrete surfaces or simple steel skids. Completely eliminates the need for expensive special foundations and crank weight wells.

And it's a breeze to counterbalance. Just one man—standing on the ground—can easily adjust the rack-and-pinion counterbalance system—without special equipment.

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JENSEN JACKS

Service Company. He more recently was associated with the cathodic protection department of Brance-Krachy Company. Adair will be in charge of Supply division sales in the southern United States.

Bariod Division National Lead Company has announced the appointment of **Billy J. Hurst,** former Drilling Mud Service supervisor, as district superintendent with headquarters at Morgan City, La. Hurst has been with Baroid since 1950. **V. S. Hefly,** former district superintendent at Morgan City, has been appointed as sales representative with headquarters at New Orleans. Hefley has been with the company for over 13 years. In Baroid's West Texas area, **R. C. Briscoe,** store manager, has been appointed sales representative with headquarters at Abilene, Texas.

Francis Anderson has been named new manager of **Halliburton Oil Well Cementing Company's** chemical research and development laboratories. He succeeds the pioneer Halliburton chemist **Hayden Roberts,** who retired. In his new position, Anderson is in charge of some 65 technical personnel in the laboratories section of Halliburton's technical center at Duncan, Okla. He also will advise the company chemists stationed in domestic and foreign field operations.

Francis Anderson

Ken Bradshaw, former executive vice president and general manager of O. T. M. Corporation in Houston, has recently resigned his position and sold his interests in that company and has formed the **Bradshaw Steel & Forge Company.** Executive offices and plant facilities will be located at Wainwright Shipyard in Panama City, Florida. Bradshaw will continue to operate a branch office in Houston. A number of important positions with the new company have already been filled. Key personnel associated with Bradshaw are former associates including **Mrs. Rex Huddleston,** executive secretary to Bradshaw; **W. J. Mann,** controller and director of the accounting department and **Bill Phillips,** sales manager.

Ken Bradshaw

Bucyrus-Erie Dedicates New Canada Plant

More than 500 guests attended the Bucyrus-Erie Co. of Canada, Ltd., plant dedication and reception at Guelph, Ont., recently where that company staged a plant tour and an equipment demonstration. Five major models of cranes and excavators, three of which are now being built at the Guelph plant, formed the nucleus of the show on the test grounds.

Customers, distributors, Bucyrus-Erie officials and local provincial and federal government dignitaries, in addition to the press, comprised the group of visitors. A dinner followed the equipment demonstration, with government dignitaries and company officials as after-dinner speakers.

Hughes Tool Names Woods Research Chief

Henry B. Woods has been named director of research of the Hughes Tool Company. Woods has been acting director of research since August. He is also recognized in the petroleum industry as one of the nation's foremost rock bit research scientists.

Henry B. Woods

Woods holds 15 patents, issued in connection with the development of rock bits and tool joints, and is author and co-author of 20 technical papers, four of the most widely-circulated of which pertain to the solution of crooked hole problems. He has been identified with Hughes research and engineering departments for the past 34 years.

Modern Store-Office Opened by Jones & Laughlin Supply Division

Jones & Laughlin Supply Division, Tulsa, has announed the completion of a new modern store-office building to house its Shreveport district office and store.

The new modern building of steel and masonry construction will house the district sales office for the North Louisiana-Arkansas district and the supply store for the Shreveport area.

BRITISH MADE H-E 300 P.A. TRACTOR DRILLMASTER

MULTI-PURPOSE · HIGHLY MOBILE

The Hands-England Drillmaster 300 P.A. Rotary Drill is now available mounted on a Fordson Major Tractor and is illustrated on left.

This design provides great manoeuvrability and is intended primarily to enable the well known H-E Drillmaster 300 P.A. Rotary Drill to be used for Quarry and Open Cast blast or shot holes.

Although the H-E Drillmaster 300 P.A. mounted on a diesel engined tractor, is ideal for Quarry and Open Cast operations, it is equally applicable to some difficult "off the road" locations, such as may be encountered during seismic exploration particularly in highly cultivated areas.

An air compressor giving 99 C F M can be mounted directly onto the drill subframe and driven from the tractor engine. This compressor gives an up-hole annular velocity of 3,000 ft./min. when using flush jointed drill pipe and holes of the following sizes:

1⅝" o/d. Drill Pipe	2⅞" dia. hole	
1.29/32" "	3⅛" "	"
2⅜" " "	3⅜" "	"
2⅞" " "	3¾" "	"

Larger holes or holes drilled with mud circulation can of course be drilled, but the equipment for these operations must be mounted on a separate trailer or tractor.

The H-E Tractor Drillmaster will be found to cover the majority of drilling requirements of the Quarry and Open Cast operator, the Geologist, the Mineralogist, and the Geophysicist.

Write for illustrated folder, full detail and specifications of this equipment quoting Reference D/TD.

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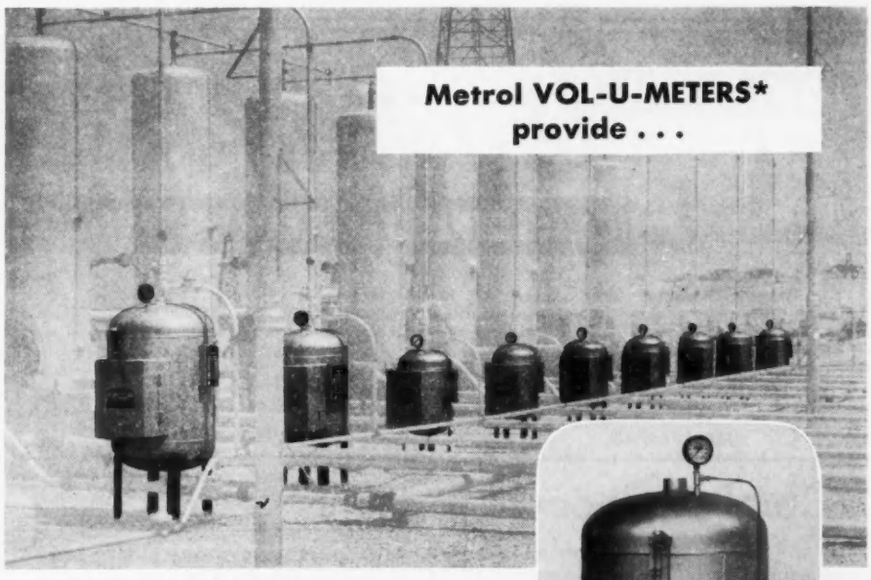

A Battery of CV Vol-U-Meters in service near Talara, Peru.

DEPENDABILITY & ACCURACY

IN METERING CRUDE OIL

Metrol VOL-U-METERS* provide a dependable and accurate means for metering crude oil by cyclic accumulation, isolation and discharge of equal volumes. Each cycle represents a known volume of liquid. The total volume passed through the VOL-U-METER is easily determined from counter readings.

Metrol VOL-U-METERS are approved by regulatory bodies for measuring oil for royalty and tax payments. Other uses include dual completions; GOR tests, periodic production tests, and in automatic tank battery operations.

They are used with two and three phase vertical and horizontal separators, and with vertical and horizontal emulsion treaters.

Two types of VOL-U-METERS are furnished. Type "CV" utilizes a single LLC pilot that is actuated by a single float. Type "FV" utilizes two LLC pilots with each pilot actuated by a float, each float being located in a reduced diameter neck. Pneumatic, electro-pneumatic, or electric controls can be furnished on both types of units. The two types of VOL-U-METERS provide equal accuracy and dependability.

Metrol VOL-U-METERS are calibrated and performance-tested before shipment, and the exact dump range stencilled on the name plate. All units are shipped ready for quick installation.

Model 10-CV-01 Vol-U-Meter

METROL VOL-U-METER FACTS:

Sizes & Capacities: Sizes are available from 0.25 to 30.0 barrels per dump, providing metering capacities from 300 to 20,000 BPD. These units will meter from "no flow" to "maximum flow" with equal accuracy. The "Unit Volume" per cycle will not vary after the unit is calibrated and put in service.

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HELP WANTED

Chief Engineer

Oil tool manufacturer has excellent opportunity in the Houston Area for a capable, experienced Chief Engineer. Must be a graduate Mechanical Engineer with at least five years experience in oil field tool and equipment design and manufacture. Salary and benefits commensurate with ability. All replies in strict confidence. Box 188-W, WORLD OIL, Houston, Texas.

SALES ENGINEER WANTED

Well-established successful firm has opening in an expanding sales department for young man looking for an opportunity in sales work. Must be college graduate, not over 33, in good health and not afraid of work. Oil industry experience desirable. Applicant will be trained at home office before moving into sales work on basis of salary plus commission incentive and travel ng expenses. Our own sales personnel know of this advertisement. Your reply will be confidential and should be sufficiently complete to merit contacting you for an interview. Address Box 187-W, WORLD OIL, Houston, Texas.

SITUATIONS WANTED

■ Production or work over foreman three years college, 27 years experience, 16 years in secondary recovery. Box 180-W, WORLD OIL, Houston 1, Texas.

■ Husband-wife teaching team desires overseas employment. Ages 28 & 26. One years experience. B.S. in social studies and speech education. Currently teaching: government, geography, history of civilization, current history, sociology, psychology, speech and drama. English, phonetic bases of speech. For clarification and information, contact Mr. & Mrs. John Sims, All Saints Episcopal Girls' School, Vicksburg, Mississippi.

■ OIL FINDING GEOLOGIST—10 years major oil company experience all phases oil exploration. Desire position of responsibility with aggressive small company or independent in Rocky Mountains or Canada. Box 185-W, WORLD OIL, Houston, Texas.

■ Exploration Geologist, 40, management experience, familiar with production and well completion problems, Permian Basin experience. Desires change. References. Box 189-W, WORLD OIL, Houston, Texas.

CONSULTING GEOLOGIST

Thirty-three years experience exploration & development—Texas-Louisiana, desires connection with active independent oil operator. Retainer & Interest basis. Box 186-W, WORLD OIL, Houston, Texas.

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■ Want oil lease offers on 180 acres near Sour Lake, Texas, Box 184-W, WORLD OIL, Houston, Texas.

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ROTARY RIGS: Variety available, including Cardwell, Oilwell and Wilson.
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Cardwell AL w/Model 75 Mast
Cardwell AL w/Model 75 Mast
Franks 658 DTM, Truck-Powered
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WORLD OIL Classified Ads

Don't Cost.. They Pay

BOOKS

THE DEEP EDWARDS TREND IN SOUTH TEXAS, Oil Frontiers Publishing Company, Box 2211, Capitol Station, Austin 11, Texas, Edited by Arthur Troutman.

This is a reference report giving attention to the Edwards Lime areas of South Texas. It is a complete summation of the factual data as well as historical resume and related aspects for either field or office use.

OIL AND PETROLEUM YEAR BOOK, 1958, Walter E. Skinner, 20 Coptthall Avenue, E.C.2, England, $7 net, post free.

The 1958 issue of the "Oil and Petroleum Year Book" is now available. This issue constitutes the forty-ninth edition and is an accurately compiled publication of its kind stating information concerning companies actively producing oil and those engaged in oil refining, transportation, marketing and financing oil development.

It might well be noted that attention has been directed to offshore drilling, despite the difficulties and rising expense for this type of exploration.

EXPLORATIONS EAST OF THE HIGH ANDES, Pageant Press, 101 Fifth Avenue, New York, Victor Oppenheim, $5.

Explorations East of the High Andes is the recorded experiences of a geologist, Victor Oppenheim, in the eastern ranges of South America's Andes Mountains.

Oppenheim has dedicated many years to the geological study and exploration of South America and was consultant to many of its governments. He has assembled in his book an educational venture, not only in geology, but also in mineralogy, ethnology, anthropology, sociology, etymology, epistemology, history, geography and other sciences underlying man's existence. They are communicated well with all the color, action, excitement and suspense of a thrilling adventure story.

THE GREAT OILDORADO, Random House, 457 Madison, Avenue, New York, Hildegarde Dolson, $3.95.

The Great Oildorado is a colorful descriptive account of the early "oil boom" town of Pitthole, Penn., the site of the first oil discovery in the U.S.

The author was born and brought up in this oil section of America and has brought into her book, sketches and outlines of famous people of that era who ventured into the Pennsylvania oil rush and became millionaries. The author has brought to light facts that seem to have never before been known about some of the colorful citizens who lived and built oil empires.

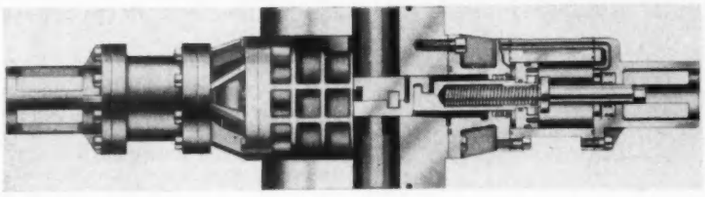
THE OIL CENTURY, The University of Oklahoma Press, Norman, Okla., by J. Stanley Clark, $3.75.

The story of oil and of the industrial and social transformation it has effected during the past 100 years is unfolded in The Oil Century. The author, J. Stanley Clark provides an extra insight into the great development of the oil industry by tracing also the course of production techniques from rank waste to conservation.

Clark's reconstruction of certain events centered around the records of the first greatest bonanza of them all should be most interesting to historians, geologists, wildcatters and to the people in general who are connected with the petroleum industry.

What's New in EQUIPMENT and SERVICES

Drilling - Production - Exploration



New Hydraulic Gate

Shaffer Tool Works has announced the development of a new hydraulic gate known as the Shaffer Type LWS Hydraulic Gate.

The Type LWS gate features a new type of heavily-ribbed alloy steel construction which combines light weight with adequate strength for different rated working pressures. The gates are easy to install and move about.

As an added feature, Shaffer states, the the Type LWS gates need not be operated by power-driven hydraulic system if extreme portability is desired. This unit will close the rams in from 15 to 20 seconds, fast enough for even urgent pressure emergencies.

The Type LWS gates also feature "swinging-end-opening" body construction for maximum ease in changing or servicing the rams without loss of operating fluid, they have positive "in-line" piston and ram design, with no yokes or complicated connections between each piston and its ram and they are equipped with many other important Shaffer advancements.

(This item supplements Shaffer Tool Works data on Pages 4505-4592 of the Composite Catalog, 23rd [1958-59] Revision.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

New Hard-Faced Coating

Metallizing Engineering Company, Inc., has developed a new powder spray gun and improved hard-facing powder.

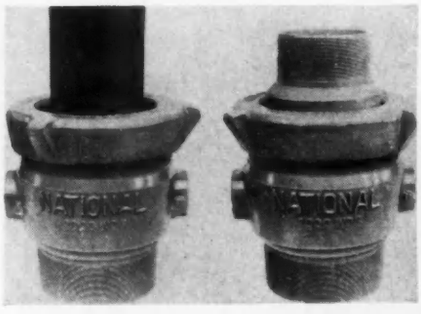
Powders used are the new nickel-boron silicon alloys which are torch-fused after spraying. These coatings range in hardness from Rc60 to 64 (meet AMS spec. 4775) and are highly resistant to hydrogen-sulfides, salt compounds and abrasive slurries.

According to the manufacturer, the only surface preparation required is grit-blasting. Another advantage of this method of application, states the manufacturer, is that the comparatively smooth surface left after fusing, plus the closely controllable coating thickness applied, results in finishing at a fraction of the costs of other methods.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Full-Opening Casing Head

Development of a full-opening casing head for 2,000 psi working pressure has been announced by The National Supply Company. According to National, it is known as the National Type G Casing Head and it includes a demountable flange and employs easily-installed pressure-actuated packing that assures a positive seal without need of precise manual adjustments.



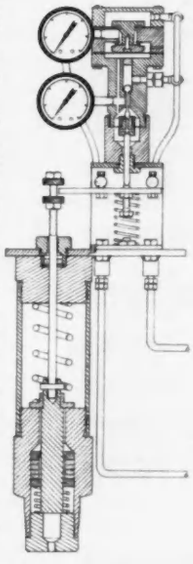
The body has two 2-inch outlets and is supplied either with a counterbore for weld or with API male casing thread lower connection. Each body accepts slips and packing units interchangeably for various sizes of inner strings. The full-opening body accommodates all drilling tools. Its male thread accepts a demountable flange, permitting "preventer control" during drilling. When the inner casing string has been run, it is suspended in the body on hinged slips, which can be passed down through standard equipment.

National states this casing head affords two methods for attaching a tubing head. In one method, after the inner string is spaced out and suspended, the tubing head is attached to it in the conventional manner by means of either threads or field welding. In the second method, a male adapter, having an internal lip type packing which seals on the OD of the suspended casing, permits the direct attachment of the tubing head with a minimum of "nippling up" time.

(This item supplements The National Supply Company data on Pages 3549-3668 of the Composite Catalog, 23rd [1958-59] Revision.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

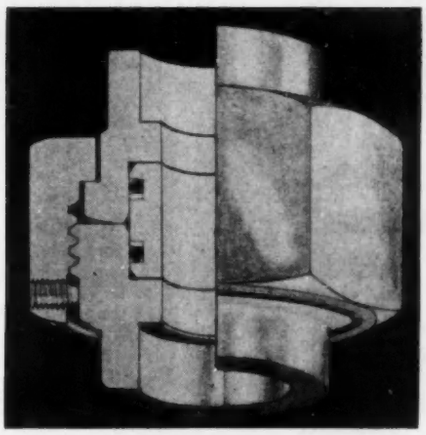
New Over-Under Pressure Cutoff



This new over-under pressure cutoff is designed to operate on increasing pressures down to 10 psi. The unit features a unique non-bleed, snap-acting pilot which eliminates small bleed orifices, thus preventing possible freezing or clogging of the pilot gas supply. The snap-action assures a higher degree of dependability since it reduces the chance for abrasive well fluids to erode the valve and seat of the motor valve.

The manufacturer states that an exceptionally simple and rugged pressure-sensing element offers a dependable guard against excessive pressures or flowline breaks, even after years of service. The element consists of a polished stainless steel plunger packed with a Teflon sleeve to reduce frictional drag. There are no tubes, diaphragms or bellows to fail or rupture. Between the flowline and pressure-sensing unit, there is no tubing that might freeze, clog or collect congealed oil. Instead, the unit is screwed directly into a tee in the flowline.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



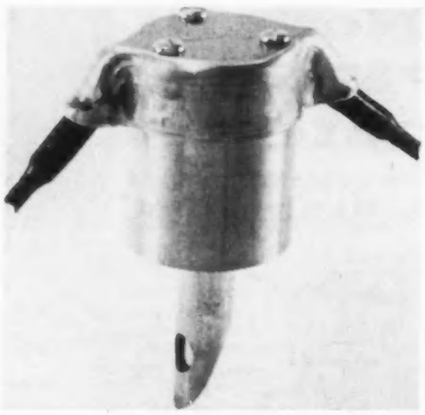
Hydraulic Pipe Union

According to its manufacturer, Sheridan-Gray Inc., Torrence, Calif., a new design in sealing surfaces permits this unusual pipe union to maintain a complete seal regard-

less of the tightness of the union nuts. The versatile union is now available in standard pipe sizes from 1 inch to 4 inches inclusive.

Sheridan-Gray states that critical sealing surfaces are completely self-contained within the union and will not become damaged during handling, welding, pickling or assembly. Constructed to withstand vibration, bending, expansion and contraction, the Sheridan-Gray Union will maintain 3,000 and 6,000 pounds working pressures. Perfect alignment is not necessary to effect perfect sealing. Expansion and contraction due to contained or external temperatures do not affect the proven sealing characteristics.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.



New S-23 Geophone

Southwestern Industrial Electronics Company, a Division of Dresser Industries, Inc., has introduced its new S-23 Geophone. The S-23-series high-sensitivity geophones have been designed to combine the advantages of high performance, low cost and quick, easy field service in any land or marsh application, according to SIE. Standard models have natural frequencies of 14, 18 and 28 cps, and models with natural frequencies ranging from 7 to 75 cps are available to special order.

S-23 geophones are contained in a hermetically sealed steel case containing an inert gas to prevent condensation, insuring long life under severe environmental conditions. A steel cap with extended flanges supports the leads where they emerge, minimizing possible fatigue breakages due to repeated short-radius bending. Simplicity and ruggedness throughout endow the S-23 with outstanding life expectancy, enabling SIE to extend its guarantee to two years on standard models.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

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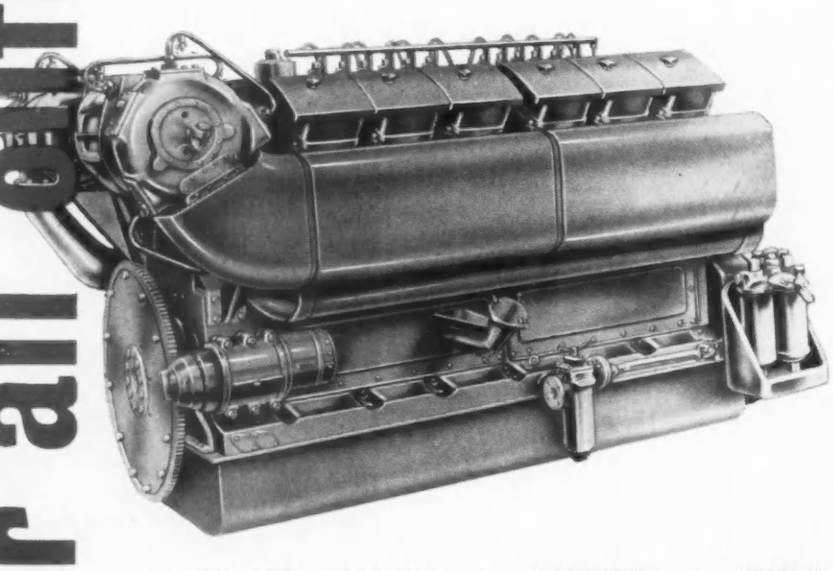

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J53

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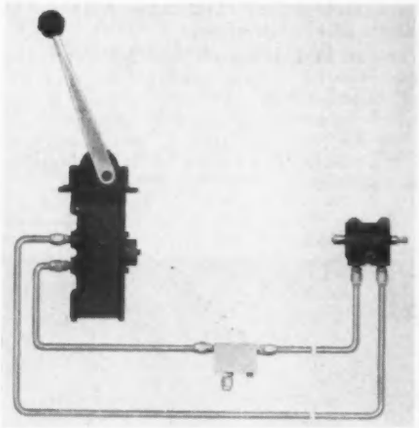


New Hydraulic System

The Hydronic Corporation of Detroit, Mich., has announced a self-contained, manually operated hydraulic system. It is used for controlling valves, clutches, transmissions, throttles and similar devices at distances up to 100 feet on many types of oil field equipment: portable drilling rigs, workover and well servicing rigs, nonportable rigs, draw works, mud pumps and geophysical truck units. The Hydronic unit also has unlimited applications for remote control of valves in refineries, petrochemical plants, gasoline plants and in compressor stations.

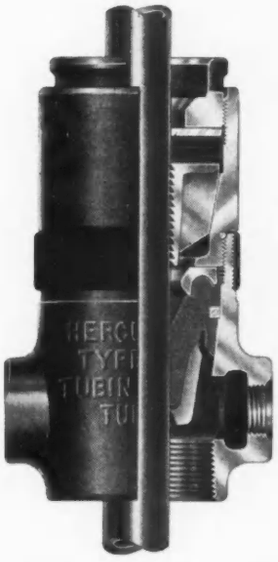
The Hydronic system consists of a master manual control hydraulically coupled to a movement duplicator, or slave cylinder. The lever-type arm transmits 500 inch-pounds of full hydraulic put in either direction through a 114-degree arc. The straight-motion slave arm delivers 1,000 inch-pounds of thrust in either direction through a 1-inch stroke.

The system is easily installed, easy to fill and operates perfectly in a temperature range from 65° below zero to 250°. It is self lubricating; is not affected by vibration; requires no maintenance and can be safely used in areas exposed to explosive fumes where electric sparks would be hazardous.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

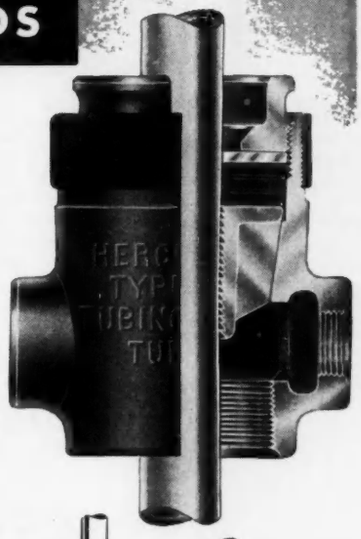
You get the most ECONOMICAL SERVICE from...

HERCULES TUBING HEADS



"TYPE J-5" TUBING HEAD

Ideal for flowing or pumping wells or for well servicing and repressuring projects. Will suspend 2" tubing to 5½" casing up to maximum of 180,000 pounds. Head is full-opening; constructed of pressure cast steel tested to over 4,000 psi. HERCULES original overhead packing arrangement and hinged slips facilitate installation and servicing. HERCULES Neoprene Tubing Stripper (2" - 2½" - 3") may be used in this head on wells flowing intermittently or to wipe tubing. Equipped with safety threads.



"TYPE J-5-S" STRIPPER TUBING HEAD

The dual purpose "Type J-5-S" Stripper Tubing Head is basically a "Type J-5" Tubing Head with a bowl (top section) screwed into the packing nut thread. The hinged slips, packing and packing nut are installed in the bowl (top section) with the tubing stripper in the body (lower section), thus permitting tubing to be run-in or removed under pressure. Test pressure is the same as the "Type J-5" Tubing Head.

Available through all supply stores

HERCULES TOOL Company

"MANUFACTURERS OF OIL FIELD EQUIPMENT SINCE 1924"

GENERAL OFFICES AND PLANT
TULSA, OKLAHOMA
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Export Representative: Oil Field Equipment Co., Inc.,

SPEED UP YOUR JOBS!

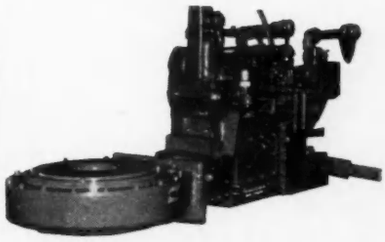
... TUBING ... LIGHT DRILL PIPE ... CASING

Foster POWER TONGS

FOUR MODELS TO CHOOSE FROM

Model	Size Range	Torque Range
54.....	2⅜ to 7"	300 to 9,000 ft. lbs.
55.....	4½ to 10¾"	500 to 15,000 ft. lbs.
57.....	4½ to 10¾"	300 to 8,000 ft. lbs.
58.....	1½ to 5½"	300 to 4,000 ft. lbs.

All Foster Representatives carry a complete inventory of spare parts for Foster Tongs and all models of Foster Catheads.



Model 58 Foster Power Tong
Size range 1½ to 5½ inch Pipe.
Torque range 300 to 4,000 ft. lbs.
Stripper rod wrench available

5 second MAKE-UP
7 second BREAK-OUT

Owners of hundreds of Foster Power Tongs praise their speed, torque control, and safety. Why don't you investigate Foster Power Tongs? The tongs that stay on the pipe... 4 models, strip rods or run 1½ to 10¾ inch pipe. Make and break slim hole drill pipe.

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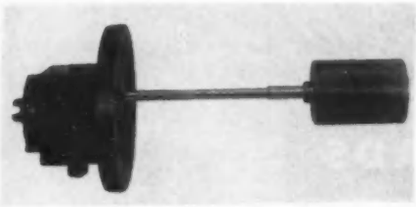
Coastal Engineering Co.....Bakersfield, California
Moore Sales & Service Company..Casper, Wyoming
Joe Perry.....Salem, Illinois
T. C. McDonald.....Shreveport, La.
Leidecker Tool Co. Ltd. Edmonton, Alberta, Canada
Langley Y Cia Srl.....Buenos Aires, Argentina
East-West Oil Tools C. A.
Maracaibo & Anaco, Venezuela



Liquid Level Control

Instruments, Incorporated has announced the newest addition to their line of liquid level controls. Named the Mic-O-Flex, it incorporates the flexure tube principle in its construction to provide an accurate and dependable liquid level control unit.

Two fundamental physical laws are the basis of the Mic-O-Flex design:

1. A cantilever beam will flex or bend when a concentrated load is applied to the end opposite to that which is securely fixed.

2. Any solid body, or float, when immersed in a liquid, will decrease in weight by the weight of the liquid displaced. (The synthane rings comprising the float will not actually float in water or oil.) Since the degree of transmitted action is a function of the decrease in weight due to immersion, this type of float is known as a Positive Displacement Float.

The Mic-O-Flex consists of a hollow stainless steel tube called the flexure tube and the pilot rod which passes through the inside of the flexure tube. The flexure tube and pilot rod are connected together at the float end, while on the opposite end the flexure tube is securely fastened, allowing the pilot rod to move freely with the action of the float and actuate micro switch.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

FOR USE IN DRILLING OPERATIONS

Kirkose

SPANS THE WORLD

'KIRKOSE' SODIUM CARBOXYMETHYL CELLULOSE • USED ON A WORLD-WIDE BASIS FOR FLUID LOSS PREVENTION • AVAILABLE IN LOW AND HIGH VISCOSITY GRADES • SALT RESISTANT SUITABLE FOR BRINE MUDS AS WELL AS FRESHWATER MUDS

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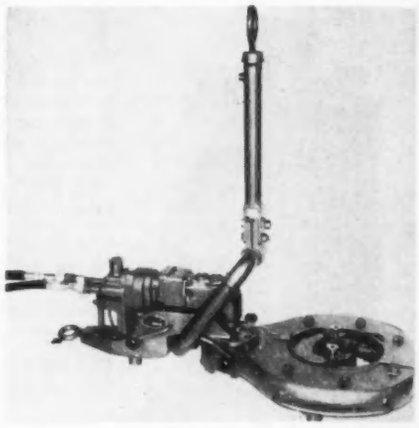


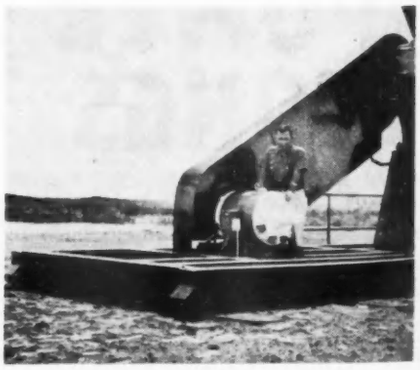
Hydraulic Tubing Tong

A new hydraulic power tubing tong for fast, smooth, economical operation has been announced by Hillman-Kelley. According to the company, the tongs feature quick, easy change of jaw sizes and a six contact point jaw design which ratios gripping action to the torque required. And the jaw positively will not crush A.P.I. tubing and minimizes die cutting or gouging of new high-strength tubing, so states Hillman-Kelley.

Additional features include the elimination of cumbersome piping, hoses and fittings by unit construction of valve motor, a new gear type hydraulic motor which is less susceptible to dirt than vane-type hydraulic motors, a streamlined case and easy-grip handles with a new roll-over design for added efficiency.

(This item supplements Hillman-Kelley data on Pages 2337-2342 of the Composite Catalog, 23rd [1958-59] Revision.)

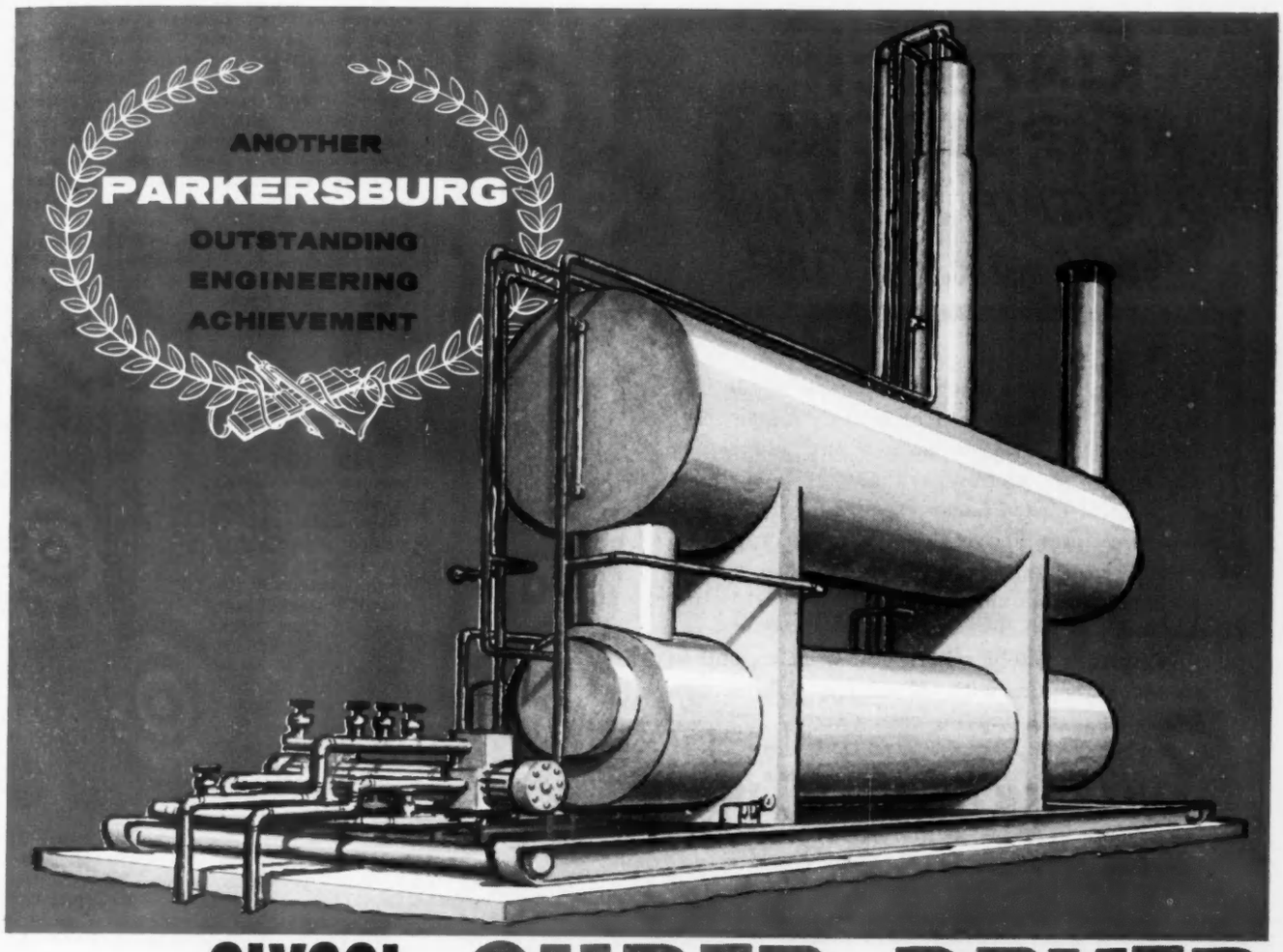
For more data, circle **No. E9** on Readers' Service Card, last page this issue.



New Electric Motors

New and larger sizes of the Green Triangle Electric Motor has been announced as now being distributed by its manufacturer, Continental-Emsco.

The new sizes are 40, 50 and 75 horsepower. The larger sizes expand the Continental-Emsco line of electric oil field pumping motors that previously covered



GLYCOL DEHYDRATOR SUPER-DRYER

PARKERSBURG
Exclusives:

- Higher dewpoint depression with lower reboiler temperatures
- Reduced glycol losses through use of integral reflux condenser
- Prevention of corrosion through airtight construction
- More water removal from glycol through better reconcentration

The PARKERSBURG Super-Dryer provides that *extra* service where conventional dehydrators are inadequate for the job, offering a *bonus* of safe reboiler temperatures demanded by such increased loads.

All units have completely automatic controls for unattended operation, even in sub-zero weather.

THE PARKERSBURG RIG AND REEL CO. — PARKERSBURG WEST VIRGINIA — QUALITY SERVICE — MADE IN U.S.A.

See Your
PARKERSBURG
Man Today!

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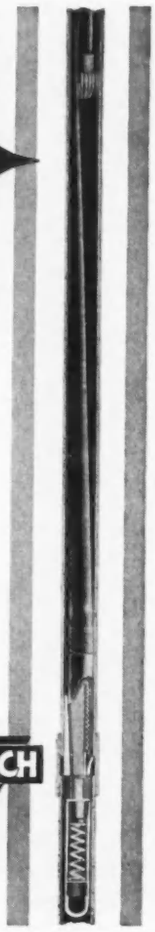
For more data on advertised products, use Readers' Service Cards, last page.

KINZBACH WHIPSTOCKS

POSITIVE SETTING... SAFE DRILL-OFF



You set your Kinzbach Whipstock at desired depth and position with absolute confidence of positive grip. Trigger assures that whipstock will be set so window will always be in only one joint of pipe. Concave section pivots on one direction hinge above slip section so upper lip always lies against pipe for safe passage of working tools; cannot be hinged into obstructing position.

Whipstock safely, where you want to, and in proper direction with Kinzbach Whipstocks. Available in all popular casing sizes.

KINZBACH TOOL CO INC

KINZBACH TOOL CO., INC.

P. O. Box 277 • HOUSTON, TEXAS

EXPORT: 74 TRINITY PLACE, NEW YORK, N. Y.

This announcement is neither an offer to sell nor a solicitation of an offer to buy these securities. The offer is made only by the Prospectus.

2,900,000 Shares

Universal Oil Processes, Inc.

(Name to be changed to Universal Oil Products Company)

Capital Stock

(Par Value $1 Per Share)

Price $25 per Share

Copies of the Prospectus may be obtained in any State only from such of the several Underwriters, including the undersigned, as may lawfully offer the securities in such State.

Lehman Brothers

Smith, Barney & Co.

Merrill Lynch, Pierce, Fenner & Smith
Incorporated

February 5, 1959

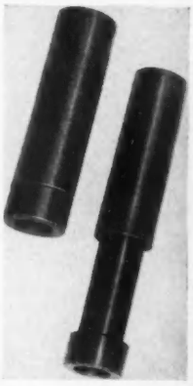
a range of 3 to 30 horsepower.

At the same time Continental-Emsco announced the availability of 900 rpm Green Triangle Electric Motors. This slower speed electric motor is available for pumping with single reduction gear reducer pumping units and wells needing a slower pumping speed than afforded by the regular 1200 rpm speed motor. These motors are available in sizes of 3 horsepower through 20 horsepower.

(This item supplements Continental-Emsco Company data on Pages 1365-1436 and 1437 and 1498 of the Composite Catalog, 23rd [1958-59] Revision.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

PVC Expansion Joint

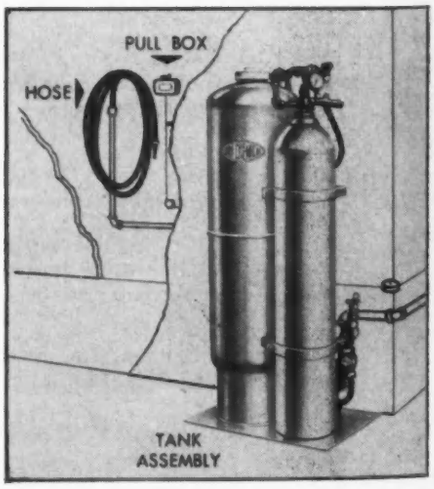


A rigid polyvinyl chloride (PVC) expansion joint which is fully guided even when completely extended, according to the company, has been introduced by the Walworth Company of New York. The new joint is an addition to Walworth's PVC line which includes Y-globe valves, diaphram valves, check valves, bleeder valves, sediment strainers and pipe fittings.

Maximum traverse of the new expansion joints is 4 inches. Walworth states it compensates for variations in length on long straight runs of both normal impact and high impact PVC pipe due to changes in temperature. Normal impact PVC pipe has a coefficient of liner expansion about five times that of steel; high impact PVC, about 10 times that of steel.

Specially designed O-rings in the new joint assure an absolutely tight seal. The PVC joint will hold at pressures which are well above five times the maximum recommended pressure for the equivalent size Schedule 80 pipe.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.



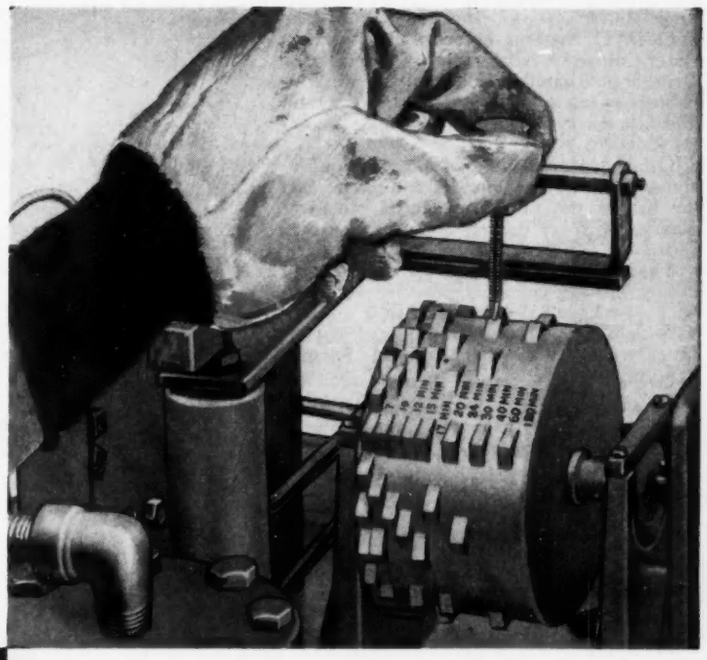
Dry Chemical Hose Line

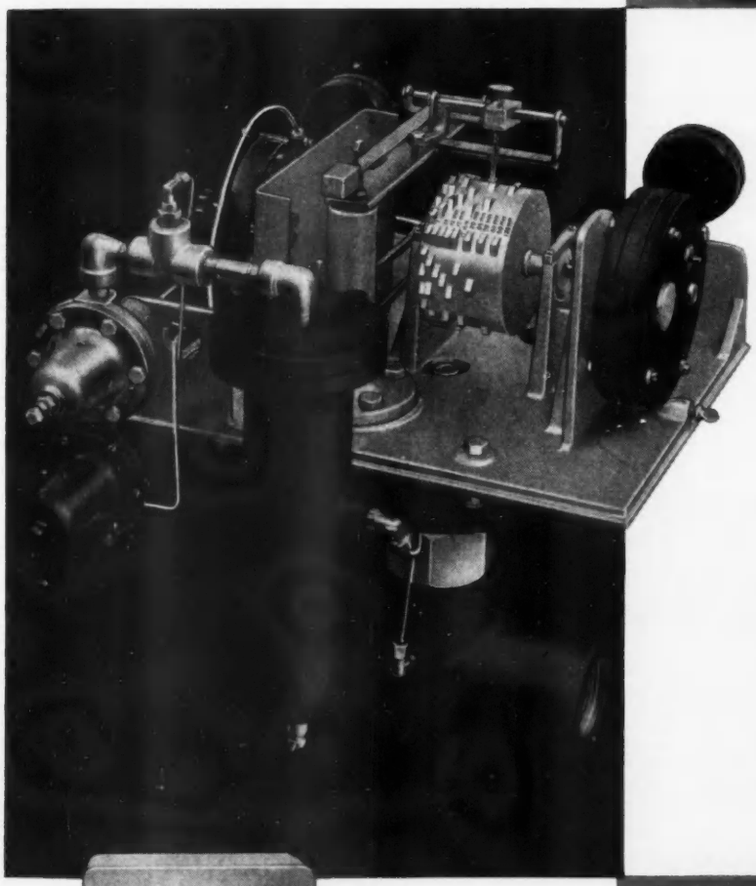
Complete remote control from a distant hose site pull box is one of the several features of the new stationary dry chemical

Accurate Gas Lift Time Cycle Control With Finger-Tip Adjustments

GUIBERSON'S AF

Intermitter-Regulator





Here's a real *oil field tool.* A rugged, long lasting intermitter-regulator for gas lift, which can be accurately set by a field man *with his gloves on*.. no special tools needed.

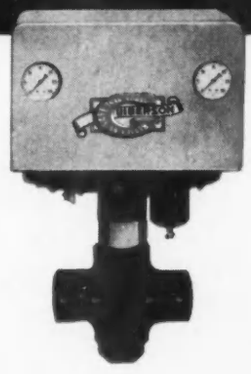
Note the intermitter-regulator with the cover removed. See how simple and trouble free the mechanism is.. no loose pins to set.. no tiny parts to adjust.

Select a time cycle by moving the adjusting screw along the slide bar until it lines up with the desired time embossed on the drum. Then set the injection time by turning the adjusting screw. Turning right increases.. left decreases.

Cycle frequencies are possible from an every five minute maximum to a minimum of one injection per revolution of the two-hour clock. Each cycle repeats with reliable accuracy.

For use as a pressure regulator, back off the adjusting screw until it clears timer drum tabs. Set to hold desired pressure with adjusting knob on the bourdon tube. It's as simple as that.

All parts are corrosion resistant and precision-made for long life and dependable service.



Ask your Guiberson representative about the multiple control problems you can solve with Guiberson equipment.

SAFE THAN SORRY — BETTER BE — GUIBERSON

THE

GUIBERSON

CORPORATION

ESTABLISHED 1919

ONE OF THE DRESSER INDUSTRIES

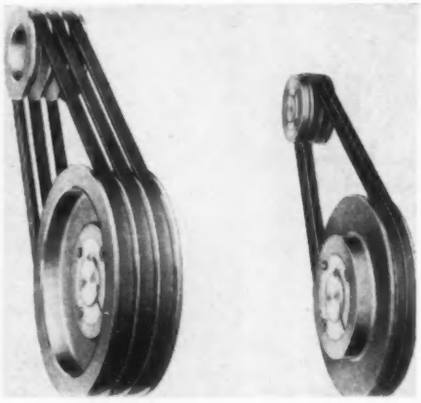
DALLAS, TEXAS U. S. A.

hose line systems developed by the C-O-TWO Systems division of The Fyr-Fyter Company. According to the company, a single pull handle at the hose site simultaneously opens the valve, pressurizes the tank and fills the system with fire-killing chemical powder.

Other features include space-saving installation, improved nozzles and valves and the use of the new Formula H chemical powder with its proven heat-and-moisture resistance.

Three models are offered—150-, 300- and 500-pound dry chemical capacity—in compact "package" designs requiring a minimum of floor space. Each model carries Underwriters' Laboratories and Factory Mutual approval.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.



New V-Belt Drives

A completely new line of V-belt drives has been announced by Dodge Manufacturing Corporation.

Introduced under the trade name Dyna-V, according to the company the new line of drives covers the complete range of horsepower capacities available in conventional drives.

Dyna-V drives are being offered in two standard groove sizes to meet all except the largest industrial requirements. Besides the ⅜-inch (nominal top width) size, known as 3V, the company is manufacturing a 5V, or ⅝-inch size for higher horsepowers. Sheaves in the 3V series, from 1 to 10 grooves, are designed for drives ranging from 1 to 50 horsepower. The 5V series will include sheaves to take from 3 to 10 of the ⅝-inch belts, and will handle drives up to 200 horsepower.

Dyna-V belts, besides being smaller in cross-section, lighter in weight and stronger, are exceptionally immune to stretching. This solves the problem of matching belts for uniform tension. According to the company, the new belts are designed with a crowned top and concave sidewalls for maximum efficiency. They have all the premium qualities, being oil and heat resistant and static conducting.

(This item supplements Dodge Manufacturing Corporation data on Pages 1547-1551 of the Composite Catalog, 23rd [1958-59] Revision.)

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

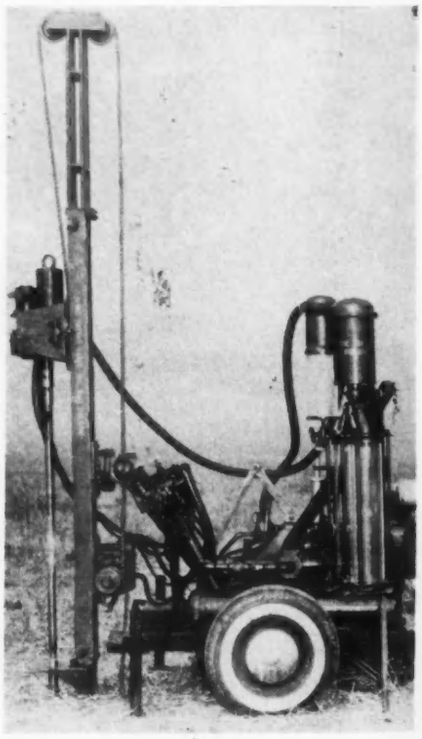
ANVIL Brand threads are clean, accurately tapered, and electro-galvanized; chamfers and recesses are precision machined. The result is a coupling that makes up fast and firm, without galling.

When you're making string—or pulling it—Anvil Brand Couplings give you the trouble-free service that helps you get lower costs on drilling and production.

Anvil Brand Fittings—A.P.I. Couplings for all oil field uses, as well as bushings, plugs, and nipples, are sold through your nearest supply store. Engineering service is always available from Anvil Brand Representatives in key oil country locations. Write today for information.

PITTSBURGH PIPE AND COUPLING COMPANY
ALLISON PARK, PA., U.S.A.
In the Greater Pittsburgh Industrial District
Subsidiary: Anvil Products, Inc., Longview, Tex.
Affiliate: Canadian Coupling and Fittings, Ltd., Simcoe, Ont.

ANVIL BRAND
forged seamless and wrought steel pipe fittings



Hi-Vac Injector Drill

The Houston Tool Company, Santa Susana, Ventura County, Calif., announces a new hydraulically operated, completely self-contained injector drill. According to the Company, it meets all the needs in the field for any type of rotary drilling operation in its class. This new drill, the "Houston-Hi-Vac Injector Drill," Model H. D. 250, drills in six different ways:

1. Vacuum-giving a 100 percent instant recovery of all cuttings in dry formation;
2. Reversed Water or Mud Drilling-

YOUR DRILLING DOLLARS GO FURTHER WITH

..FIELD PROVEN

CONTINENTAL-EMSCO "D" Series Slush Pumps

These six models meet all conditions from light portable rigs to high-pressure deep well drilling:

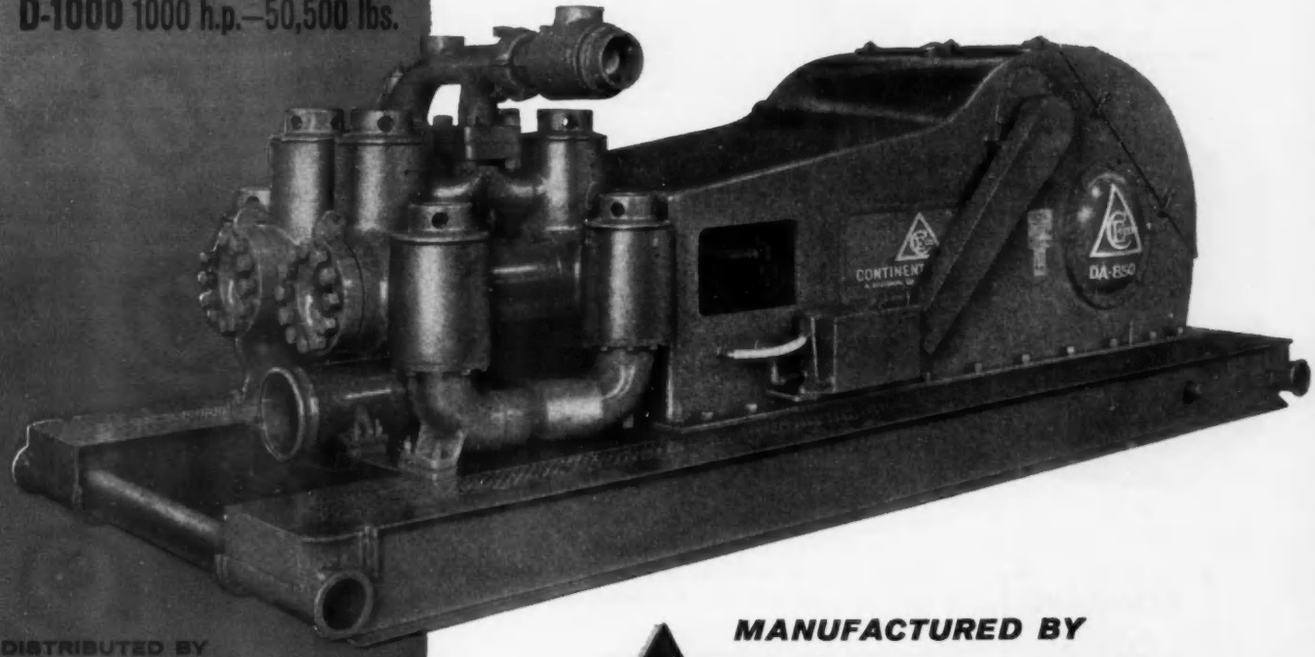
D-175 175 h.p.—10,700 lbs.
D-300 300 h.p.—16,900 lbs.
DA-500 500 h.p.—28,000 lbs.
D-700 700 h.p.—37,500 lbs.
DA-850 850 h.p.—49,090 lbs.
D-1000 1000 h.p.—50,500 lbs.

No *wasted* dollars here. Low weight of these pumps cuts transportation costs . . makes them easier to handle around the rig for faster spudding-in. Lightweight steel plate construction replaces bulky, heavy castings.

Maintenance downtime is greatly reduced. Daily adjustments are not necessary. Lubrication is completely automatic, and greasing is not required. Patented "exposed" liner design helps prevent liner washouts, since packing leaks can be spotted immediately . . long before damage can be or has been done.

Six models help cut initial investment by providing a range of sizes to meet all drilling conditions at the lowest possible cost.

High performance of "D" Series pumps . . proved by years of drilling in the oil fields of the world . . assures penetration at its fastest rate.



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General Offices: Dallas, Texas • Plants: Houston and Garland, Texas

SP-802

retaining 97 percent recovery of all wet cuttings;

3. Standard Forced Water or Mud Drilling;

4. Diamond Drilling by Vacuum or Water;

5. Standard Continuous Flight Auger Drilling;

6. Compaction Test Drilling-taking a 2-inch O. D. undisturbed drive core.

According to the company, it will drill at any angle in any kind of formation. It will drill a 2⅜-inch hole to 150 feet, a 3⅛-inch hole to 100 feet, forced water drill to 250 feet and continuous flight auger drill to 100 feet. It weighs 1800 pounds and can be mounted on any four wheel ¾-ton pickup, truck or on a tandem wheel trailer.

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

New Electric Level-Trol

Fisher Governor Company state their engineers have designed and perfected an electric Level-Trol, the Type 2300. Using the conventional pneumatic Level-Trol cage and displacer float as the measuring element, it delivers a proportional 1 to 5 milliampere dc signal through a 3000 ohm load.

Standard 117 volt alternating current is employed as the supply. Explosion-proof design and external adjustments for proportional band and liquid level height render the Type 2300 suitable for use in hazardous locations.

(This item supplements Fisher Governor Company data on Pages 1753-1760 of the Composite Catalog, 23rd [1958-59] Revision.)

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

THE ORIGINAL

PORTA-KAMP HOUSTON

Trademark

pioneers of collapsible, portable, field housing.

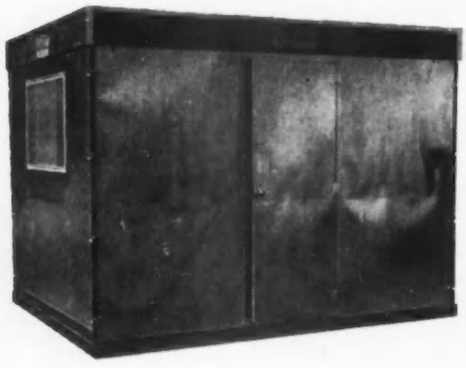
USED WORLD-WIDE.

Can be erected in 15 minutes!

Model D-I-C $585 FOB plant
Size 10′ x 10′

- **Shipping case size— 40″ x 10′ x 14″**
- **Weight—550 lbs.**
- **Also available in size 10′ x 20′, model 2D-1-C**
- **Costs less than tents— let us prove it!**

Model D-I-C



Model K-10

$995 FOB plant
Size 8′ x 10′

- **Fully insulated**
- **Join several units together**
- **Weight—950 lbs.**
- **Shipping case size— 8′ x 10′ x 15″**

PORTA-KAMP now offers:

- **Custom designed buildings to your specifications, extra heavy duty, steel skid mounted, collapsible buildings.**
- **Complete camp outfitting, including all miscellaneous supplies.**
- **Export crating.**

COMPARE COSTS!
Write for free literature today.

PORTA-KAMP MFG. CO., INC. P. O. BOX 7064 HOUSTON 8, TEXAS

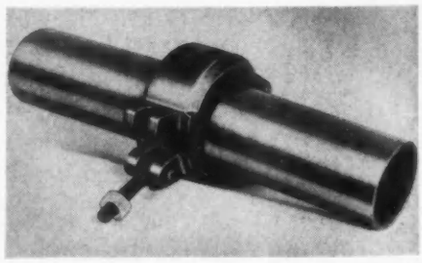
Safety Coating Kit

The Ring Chemical Company, Houston, has announced its new "Safety Tread Coating." It adheres to such base materials as steel, concrete and wood, and it is said to be easily applied by brush or squee-gee and cures for traffic in a few hours.

The kit, sufficient to cover approximately 50 square feet of concrete, includes a container of plastic resin, one of activator and a shaker-top can of abrasive grit. The resin and activator are stirred together and applied immediately to the surface. While still tacky, the coated area is sprinkled with grit.

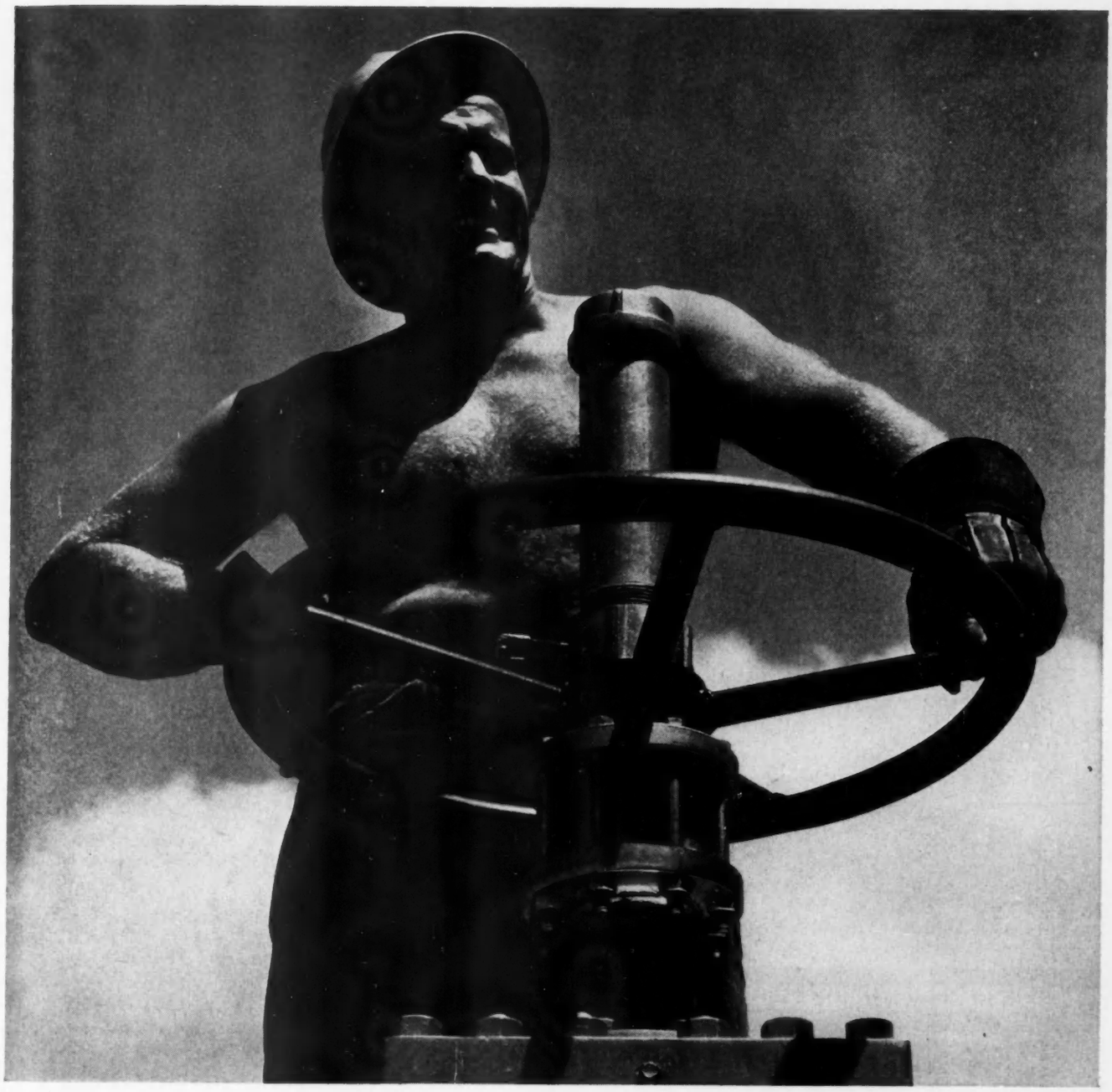
The cured surface resembles that of fine sandpaper and, because of the powerful bond of the resin, cracking, peeling or chipping is eliminated. The coating cost ranges from 12 to 20 cents per square foot, depending upon the surface material and the area.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

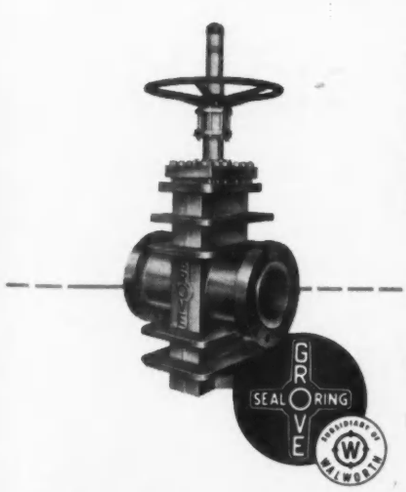


Swing Bolt Coupling

A new malleable iron Swing Bolt Coupling has been added to the line of the Charles E. Manning Company, manu-



You're never stuck with a GROVE VALVE



Here's the valve you set and forget. Grove's exclusive Seal-O-Rings wipe out the need for valve lubrication. You're never stuck with valve failure because of forgotten lubricant or depleted sealing compound. The load of lubrication is gone forever. Specify Grove Seal-O-Ring Gate Valves. Under pressure the tightest seal in the line.

Grove valves never require lubrication

GROVE VALVE and REGULATOR COMPANY

65th & Hollis Street, OAKLAND 8, California

HOUSTON 27—3203 Mercer St. • LOS ANGELES 6—2559 W. Olympic Blvd.

ODESSA • TULSA • DENVER • CHICAGO • NEW YORK • DALLAS • PITTSBURGH

FARMINGTON, N. M. • LAFAYETTE, LA. • HARVEY, LA. • LONGVIEW, TEXAS

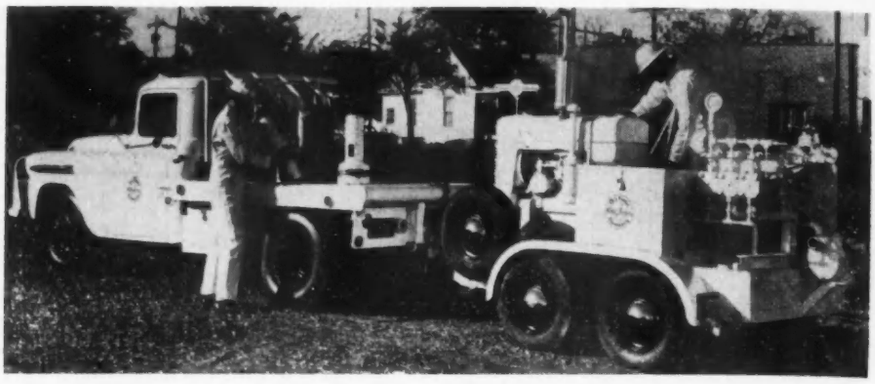
In Western Canada: GROVE VALVE LTD., EDMONTON

facturers of Alumiron grooved-type couplings and fittings.

The new swing bolt coupling cuts installation time and labor by 25 percent when applying couplings to grooved-end pipe, according to the company. Simple to use, one man can apply the gasket, put the housing in position, swing the bolt closed and tighten the single nut in a matter of minutes.

The new swing bolt coupling is designed with a positive, safe locking device that can't snap open, so states the Manning Company. It is rated up to 500 pounds working pressure, and is available in 1-, 2-, 3- and 4-inch sizes.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.



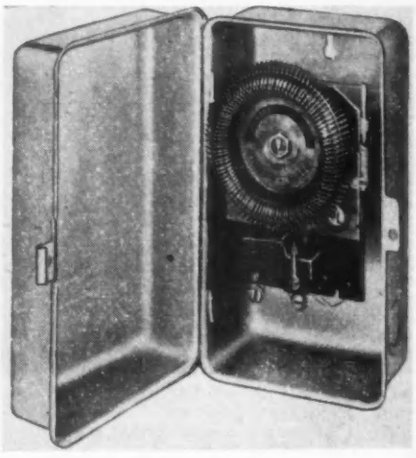
Blowout Testing Service

A blowout preventer testing service has been added to the list of operations of the Oil Field Rental Service Company. Officials of the company say the new service will provide fast, efficient testing of blowout preventers on the rig after they have been nippled-up.

The company's engineers say the testing service will provide greater safety for workers around the rig and help protect the owner's investment. This portable unit, with qualified operators, goes right up to the rig to provide complete blowout preventer testing service.

The testing service is complete and includes high pressure pumps for testing up to 15,000 psi, operators trained to test all types of preventers, test plugs to fit all types of wellhead equipment, dual or single.

For more data, circle **No. E18** on Readers' Service Card, last page this issue.



Built-In Random Start

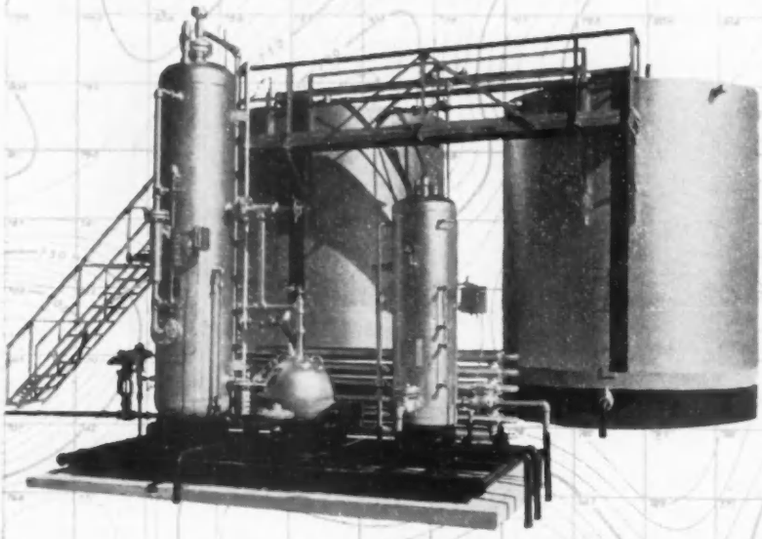
A program time switch developed specifically for oil field pumping control has been announced by Tork Time Controls, Inc. Called the Model 8005, the unit, according to the company, prevents any two pumps in a field from coming on at the same time and it protects equipment and wiring against overload of initial surge current.

In the 8005, each switch has a built-in time delay start contact. The company states it's possible for any two to close at the same time after the restoration of power.

The "intermittent start contact" on the Tork 8005 does not have to be set. However, convenient manual operation of the time delay start contact is possible, at any time, without disturbing automatic settings. The Tork 8005 is available in models for 120-volt, 208-240-volt and 440-volt usage.

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

ON LOCATION FOR ONE BIG REASON . . .



Tysco Type CTS Cold Temperature Separator on stream at Texkan Oil Company's Unit "A" in the Whitted Field in Hidalgo County, Texas.

IT INCREASES HYDROCARBON RECOVERY!

Before putting their Unit "A" on stream, Texkan Oil Company, Dallas, Texas, wanted to be sure of getting maximum hydrocarbon recovery. After an investigation of many good cold temperature separators, they chose a Tysco Type CTS Cold Temperature Separator. The one unit that *gives* maximum hydrocarbon recovery.

The Tysco CTS Cold Temperature Separator installed for Texkan has a 7 MMCFD capacity. This unit is increasing recovery from Texkan's gas-distillate wells by as much as 15 per cent by recovering products that would normally be lost in the sales gas. *And*, the Tysco Separator will pay itself out in a minimum of operating time.

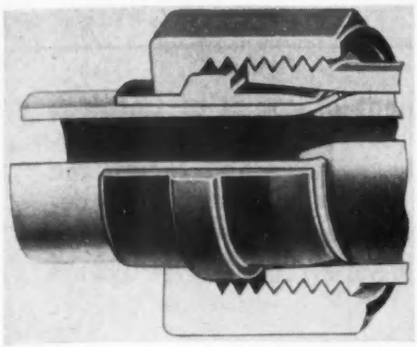
But increased hydrocarbon recovery is only one reason for selecting Tysco oil and gas process equipment. Equipment dependability and service after installation are also big factors. When you specify Tysco you get all three! Maximum recovery – Dependable equipment performance – On-time service.

Find out the advantages of using Tysco process equipment for yourself. Consult with a Tysco Sales Engineer before you put your next well on stream; there's no obligation.

TYSCO **TYSON SMITH CO.** ONE OF THE SMITH INDUSTRIES

8000 Hempstead Highway • Houston, Texas

SERVING INDUSTRY WITH QUALITY PRODUCTS, DEPENDABLE SERVICE.



Self-Flaring Tube Fitting

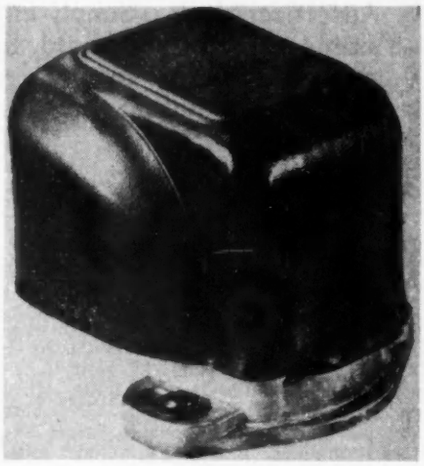
A new self-flaring tube fitting has been developed by the Flodar Corporation of Cleveland. According to Flodar, the new tube fitting combines many of the advantages of both the standard flared type and the newer flareless type with few of the disadvantages.

The new fitting employs a hardened steel sleeve to press the tube into the contoured body to form a flare as the fitting is tightened. In doing so, according to Flodar, the fitting forms a pressure tight seal on both the OD and ID of the tube. A slotted skirt on the rear of the sleeve supports the tube absorbing excess vibration.

In tightening the fitting, the nut comes to a "rock bottom" stop as a perfect seal is effected thus, preventing overtightening, a serious hazard on the flareless tube of fitting. Because of the nature of the seal obtained, the fitting can be reused frequently without danger of leakage.

Flodar Sel-Flare type fittings are available in all standard tube sizes from ⅛ inch to 2 inches and all common styles. Materials available include steel, stainless steel, brass and aluminum.

For more data, circle **No. E20** on Readers' Service Card, last page this issue.



Plastic Magneto Covers

The Carson Plastic Magneto Cover has proven itself to be a big help in protecting the magnetos from precipitation and condensation and by helping to control temperature changes, according to its manufacturer, the Plastic Division of Serv-A-Car Products, Inc., Parsons, Kan.

Serv-A-Car states that their protection pays off in preventing break-downs and providing continuous service with less maintenance and repair. Covers are available for all standard make magnetos and are fabricated of high grade industrial plastic.

For more data, circle **No. E21** on Readers' Service Card, last page this issue.

New Type Insert Bit

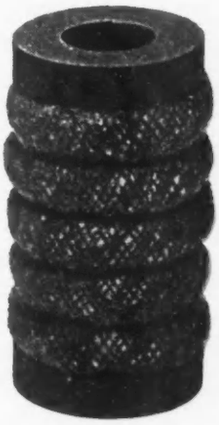
The Gault Tool Company, Seismograph Division, has announced the development of a new type insert bit for seismograph drilling. Gault states the new insert bit is simple and rugged in construction, efficient in action and is fabricated of high quality steel. It is in one piece with three blades spread radially at 120°, gives improved efficiency and economy in rotary drilling for seismic exploration and it eliminates time-consuming field assemblage of multiple unit bits.

According to the company, the Gault Insert Bit has longer life because each blade is inclined from its base toward the right hand rotation of the bit which gives a slicing tearing action as opposed to the vertical drag of other insert bits, because the inclined blade in action gives the bore hole cuttings an upward and outward thrust. The Gault insert bit gives a clean open hole. It has smoother, faster penetrating action of pilot cutters because the pilot inserts have specially designed angles, and it cuts 95 percent of all formations encountered in seismic exploration drilling.

For more data, circle **No. E22** on Readers' Service Card, last page this issue.

NO OTHER PACKING LASTS AS LONG

MARLO Polished Rod Packing is the most cost-cutting and long-lasting packing found in any oil field, anywhere.



RW-6E Sets for Round Stuffing Boxes

1 MARLO outlasts ordinary packing up to 8 and 10 times, and *more*.

2 MARLO saves oil, reduces wear on rods, saves labor.

3 MARLO does not harden or burn during pump-off.

4 MARLO is anti-frictional. Its resilient, corrosion-resistant, semi-metallic rings form a dense, shock-absorbing, bearing-like surface.

5 MARLO has been proved in the field and standardized on by more and more leading producers.

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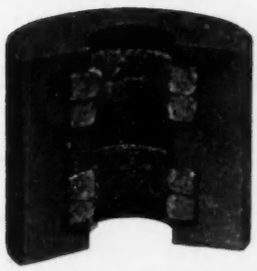

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New Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Readers' Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Tube Size Bulletin

Surf Chemical Incorporated, specialists in extruded Teflon and an affiliate of Driver-Harris Company, Harrison, N. J., describes their enlarged range of tube sizes in Bulletin 158.

Over 1,000 tubing sizes are available between .012 inch I.D. minimum to 1 inch I.D. with a selection of wall thickness from 24 mills to 250 mills. High molecular weight Teflon 5 and 7X resins are used for all extrusions to insure superior qualities. Extrusions include rods, coaxial cable cores (Mil-C17B) and aircraft and industrial hose liners.

For more data, circle **No. E23** on Readers' Service Card, last page this issue.

New Iron Booklet

The International Nickel Company, Inc., announces the publication of a 28-page booklet entitled "Engineering Properties of NI-RESIST DUCTILE IRONS."

Included in the booklet are tables and graphs clearly explaining the mechanical and physical properties, erosion and corrosion resistance and the high temperature strength properties of the new Ni-Resist Ductile Iron. A special section of the booklet points out where the new product can go to work in the chemical, electrical, liquid handling and petroleum fields and in internal combustion engines, pulp and paper, and power plants.

For more data, circle **No. E24** on Readers' Service Card, last page this issue.

Hose and Tube Bulletin

Eastman Technical Bulletin 100, describing medium pressure Eastman hydraulic hose and tube assemblies, is now available for distribution. This is another in the series of new bulletins published by the Eastman Mfg. Co., which follows the same easy-to-use and easy-to-order arrangement—according to pressure requirements.

This bulletin contains 36 pages devoted to exclusive Eastman features found in medium to low pressure Eastman hydraulic hose and tube assemblies, with accurate dimensional drawings and complete tables of available sizes.

For more data, circle **No. E25** on Readers' Service Card, last page this issue.

Magnetic Flowmeter

Fischer & Porter Co., announces Application Bulletin 90-150-16, Measuring The Flow of Drilling Mud with The F&P Magnetic Flowmeter, which describes practical systems for measuring mud flow rate in rotary drilling. The why and how are discussed in full.

For more data, circle **No. E26** on Readers' Service Card, last page this issue.

Fracturing Services Bulletin

B. J. Service, Inc., a subsidiary of Borg-Warner Corporation, announces the release of a new bulletin on fracturing services. Each frac fluid and temporary blocking material used by BJ are discussed in the bulletin.

Charts compare the friction loss of these fluids in both tubing and casing. Also listed in graphic form is the effect of temperature on the viscosity and fluid loss of these specially formulated fluids. A glossary of terms used in well stimulation work concludes this booklet.

For more data, circle **No. E27** on Readers' Service Card, last page this issue.

Forged Steel Valves Catalog

Henry Vogt Machine Company has released its new catalog of forged steel valves, fittings, flanges and unions. Its 432 thumb-indexed pages feature new types and trims to meet severe fluid and gas handling duties at all temperatures and pressures.

For more data circle **No. E28** on Readers' Service Card, last page this issue.

Medium-Depth Rig Folder

The National Supply Company announces publication of a folder on the new National T-45, a medium-depth rig designed for both conventional operation and trailer mounting.

It is a compact skid-mounted rig that you can move from one well site to another with a minimum of downtime . . . yet, it has the same outstanding features and rugged construction you get in bigger National rigs.

With quick and easy removal of the catheads, air control housing, and drive group, you have a rig under 8-foot width ready for fast moves over any highway. This type of equipment enables you to get to a new location, set up and make hole without delay.

For more data, circle **No. E29** on Readers' Service Card, last page this issue.

Pumping Manual

Harbison-Fischer Mfg. Co., Fort Worth, has issued a new publication, Methods of Oil Well Pumping, a basic reference text for efficient production.

The 48-page book discusses such topics as types of reservoirs and sub-surface pressures, designs of sucker rod strings, displacement and efficiency of sub-surface pumps, the various types of pumps, methods of calculating pumping installations and also includes sections on API codes and recommended field practices and various mathematical formulas used to calculate pumping installations.

For more data, circle **No. E30** on Readers' Service Card, last page this issue.